FINAL
DATA SUMMARY REPORT

KALISPELL POLE AND TIMBER, RELIANCE, AND YALE OIL FACILITIES

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Prepared for:

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ACRONYMS AND ABBREVIATIONS

AES	Applied Earth Sciences, Inc.
atm-m^3/mol	Atmospheres per cubic meter per mole
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
BNSF	BNSF Railway Company
BTEX	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
CDD	Chlorinated dibenzo-p-dioxins
CECRA	Montana Comprehensive Environmental Cleanup and Responsibility Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
DEQ	Department of Environmental Quality
DNRC	Department of Natural Resources and Conservation
DRO	Diesel range organics
DSR	Data summary report
EPA	U.S. Environmental Protection Agency
EPH	Extractable petroleum hydrocarbons
ERM	Environmental Management Services West, Inc.
ERCL	Environmental Requirements, Criteria, and Limitations
ESA	Environmental site assessment
EWD	Evergreen Water District
°F	Fahrenheit
FIT	Field Investigation Team
ft/day	Feet per day
gal/min	Gallons per minute
GRO	Gasoline range organics
GWIC	Ground Water Information Center Wells
HRS	Hazard ranking score
HRA	Historical Research Associates, Inc
ISOS	In situ ozonation system
K	Coefficient of Thermal Conductivity
K_{oc}	Organic carbon partition coefficient
KPT	Kalispell Pole and Timber
KRY	Kalispell Pole and Timber (KPT) Facility, Reliance Refinery Company (Reliance) Facility, and Yale Oil Corporation (Yale Oil) Facility
LCS	Laboratory control sample
LNAPL	Light nonaqueous phase liquid
LWC	Land and Water Consulting, Inc.

ACRONYMS AND ABBREVIATIONS
(Continued)

μg/L	Micrograms per liter
MDHES	Montana Department of Health and Environmental Sciences
mg/L	Milligrams per liter
MS	Matrix spike
MSD	Matrix spike duplicate
MSE	MSE, Inc.
MTBE	Methyl tertiary-butyl ether
NAPL	Nonaqueous phase liquid
NPL	National Priorities List
NRIS	Montana Natural Resource Information System
NSC	National Safety Council
NTL	NTL Engineering and Geoscience, Inc.
P&E	Proper and expeditious
PA	Preliminary assessment
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCP	Pentachlorophenol
PRG	Preliminary remediation goal
PTS	Pioneer Technical Services
PLP	Potentially liable persons
QA	Quality assurance
QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based soil levels
Reliance	Reliance Refinery Company
RETEC	Remediation Technologies, Inc.
RI/FS	Remedial investigation/feasibility study
SI	Site investigation
SVE	Soil vapor extraction
SVOC	Semivolatile organic compounds
TTEMI	Tetra Tech EM Inc.
TPH	Total petroleum hydrocarbons
μg/dL	micrograms per deciliter
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOC	Volatile organic compounds
VPH	Volatile petroleum hydrocarbons
WRCC	Western Regional Climate Center
Yale Oil	Yale Oil Corporation
yd^3	Cubic yard

1.0 INTRODUCTION

The Montana Department of Environmental Quality (DEQ), Remediation Division, has compiled this Data Summary Report (DSR) for the Kalispell Pole and Timber (KPT) Facility, Reliance Refinery Company (Reliance) Facility, and Yale Oil Corporation (Yale Oil) Facility (jointly referred to as the KRY site), near Kalispell, Montana. The DSR was prepared by Tetra Tech EM Inc. (TTEMI) in accordance with the scope of work under Task Order No. 37, DEQ Contract No. 402014. This report serves as a comprehensive data summary for the data that have been collected to date, and identifies data gaps based on this summary, prior to preparation of a remedial investigation (RI) work plan.

1.1 REPORT ORGANIZATION

This DSR is organized into four sections of text, followed by a list of references used in preparing this DSR. Figures and tables follow the references section. Appendices are attached at the end of the report. The contents of Sections 1.0 through 4.0 are briefly described below.

- Section 1.0, Introduction, describes the report organization, purpose, and objectives.
- Section 2.0, Background and History, provides the site setting, describes the site history, and summarizes previous and ongoing investigations.
- Section 3.0, Physical Characteristics and Environmental Setting, describes the geography, climate, ecology, geology and soils, groundwater hydrology and surface water hydrology of the KRY site.
- Section 4.0, Data Summary, summarizes existing chemical and other relevant data for the KRY site, including an assessment of data quality and perceived data gaps.

1.2 PURPOSE AND OBJECTIVES

This DSR summarizes and evaluates existing information to identify what, if any, additional data should be gathered to complete an RI and feasibility study (FS) for the KRY site. Groundwater contamination from each of the three facilities is commingled in the unconfined aquifer, and the KRY site is located adjacent to the Stillwater River and nearby residential areas. Site assessment activities were conducted by the U.S Environmental Protection Agency (EPA) and the Montana Department of Health and Environmental Sciences (MDHES; the predecessor to DEQ) at the three facilities from 1985 to 1994. These investigations were conducted to characterize contamination in soil, sludge, and groundwater and to gather historical data for Comprehensive Environmental Response, Compensation and Liability Act

(CERCLA) purposes. A draft hazard ranking score (HRS) package was developed for the KPT and Reliance facilities that indicated the facilities were candidates for the federal National Priorities List (NPL). The objective of the DSR is to present information outlined in Task No. 2 of Task Order 37, including:

- General information such as project title and legal and general descriptions of the locations of the facilities.
- A chronological listing of owners, operators, transporters, and generators.
- A history of operations, including identification of, and a summary of any records relating to, (1) hazardous or deleterious substances; (2) dates of operation; (3) description and location (including maps) of all components, including all underground components, such as product pipelines associated with any hazardous or deleterious substance; and (4) any available historical engineering drawings of the processes for receiving, handling, and distribution of hazardous materials at the facilities.
- A comprehensive data summary of all previous investigations to date that includes maps and tables that summarize available data.
- The physical and chemical characteristics, concentrations, and volumes of media affected by the release of hazardous or deleterious substances, and an analysis of the accuracy, precision, quality, and usability of the data related to the release.
- A summary of related data from adjacent areas, as required by DEQ.
- A format for data compilation and management that is efficient and effective and that is compatible with fate and transport modeling programs, risk assessment evaluations, and public presentations.
- A comparison of existing data to screening levels.
- A summary of previous response actions conducted by local, state, federal, or private parties, including investigations or actions related to source control or removal.
- A summary of regional facility information, location, pertinent area features, and general physical characteristics, including geography, meteorology, geology, hydrology, and ecology.
- An updated well inventory within a one-half mile radius of the facilities that includes current uses, installation and completion data, screened depth, ownership, physical location, and available contaminant concentration data through June 30, 2005.
- An inventory of nearby residences.
- An assessment of data gaps for each of the three facilities.

2.0 SITE BACKGROUND AND HISTORY

This section provides background information for the KRY site, including location, an overview of the operational and property ownership, chronologic history of operations, and a summary of investigations and interim actions conducted previously.

2.1 SITE LOCATION AND SETTING

The KRY site is located on the northeastern edge of the City of Kalispell in Flathead County, Montana, outside of the Kalispell city limits (Figure 2-1). The site is located at approximately 48°11' North latitude, 114°18' West longitude, and is in (1) the Northeast ¼ of the Northwest ¼ of Section 8, (2) the Northwest ¼ of the Northeast ¼ of Section 8, and (3) the Southeast ¼ of the Southwest ¼ of Section 5; all within Township 28 North, Range 21 West of the Montana Principal Meridian. The boundaries of the KRY site extend from the Stillwater River on the north and west, Whitefish Stage Road on the west, Highway 2 and the BNSF Railway Company (BNSF) railroad on the east, and Montclair Drive on the south (Figure 2-2). The fenced area northeast of Reliance and adjacent to (east of) the railroad tracks is also part of the Reliance Facility. The site encompasses approximately 55 acres.

2.2 SITE HISTORY

This section presents an overview of the operational and property ownership history for the KPT, Reliance, and Yale Oil Facilities. Current ownership of the individual parcels in each facility delineated by DEQ is summarized in Table 2-1. Historical property ownership is presented in Table 2-2. Vicinity land use and parcel identification are presented in Figure 2-3. Figures 2-4, 2-5, and 2-6 present historical facility features identified on aerial photographs and Sanborn Fire Insurance Maps. Aerial photos and Sanborn maps are provided in Appendix F.

2.2.1 Kalispell Pole and Timber Facility

KPT is a former wood treating facility that operated from approximately 1945 to 1990. The facility encompasses approximately 35 acres. Spills or leaks of wood treating oil that contained pentachlorophenol (PCP) from the treatment vats, aboveground storage tanks, and treated wood contaminated on-site soils and groundwater with PCP, dioxins and furans, polycyclic aromatic hydrocarbons (PAH), and diesel-range petroleum hydrocarbons.

KPT was incorporated on July 8, 1944. On October 8, 1945, KPT leased from the Great Northern Railroad Company a 300 feet by 200 feet space in or near the area where the pole plant was ultimately constructed. BNSF's predecessor companies (Burlington Northern Railroad Company; Burlington Northern, Inc.; and Great Northern Railroad Company) leased portions of its property to KPT beginning on June 1, 1947, and possibly as early as October 8, 1945, for the location and operation of a treating plant and storage yard. KPT owned and operated the pole plant for its entire operating life, from approximately 1945 through approximately May 1990. The KPT board of directors approved the dissolution of the corporation as of December 31, 1990. KPT was involuntarily dissolved by the state on December 6, 1991. KPT abandoned the leased property in about May 1990. However, KPT's lease for the property has never been canceled or transferred. When the pole treating operations ended, KPT dismantled and removed all treating vats and aboveground storage tanks and piping (HRA 1995).

Historical Research Associates, Inc. (HRA) interviewed former KPT employees who provided details on the wood treating process used at the plant (HRA 1995). First, blocks of PCP were melted with hot oil (5 percent PCP by weight) in a vat using a steam process to create a "treating oil" that reached temperatures as high as 210 to 230 degrees Fahrenheit (°F). Then, the hot treating oil was added to a large vat that contained the wood to be treated for an average treatment time of about 10 hours per load. Sample drillings into the treated wood verified whether the preservative had sufficiently penetrated the wood. The treated wood was usually loaded and shipped shortly after it was treated. It was noted that "foam overs" of the wood treating solution could occur when precipitation reacted with heated oil in the treatment vats.

KPT treated poles at the pole plant using a butt vat and a full-length vat. KPT added the full-length vat to its operation in 1957 (HRA 1995). The dimensions of the butt vat were 10 feet wide by 10 feet deep by 18 feet long. The capacity of the butt vat was 13,465 gallons. In the butt vat treatment process, poles were placed vertically (upright) into the vat. The dimensions of the full-length vat were 10 feet wide by 10 feet deep by 70 feet long. The capacity of the full-length vat was 52,367 gallons. In the full-length treatment process, poles were placed horizontally into the vat. The full-length vat was also used for mixing PCP and oil (BNSF v. KPTC 2000).

KPT records show that, between September 1959 and June 1998, KPT purchased at least 2,298,081 pounds of PCP. Records also show that, between September 1959 and October 1989, KPT purchased at least 5,310,096 gallons of wood treating oil (BNSF v. KPTC 2000).

BNSF and its predecessors owned and currently own a portion of the property where KPT operated and where the wood treatment facility was located. BNSF shipped freight via railcar to and from KPT. Freight shipped by BNSF to KPT included untreated poles, PCP, and oil. Freight shipped by BNSF that was forwarded from KPT included treated poles. BNSF freight records for 1968 through 1970 show that 184 railcars of freight were delivered to KPT and that 296 railcars of freight were forwarded from KPT. Records for 1973 through 1976 show that approximately 80 railcars of freight were forwarded from KPT. BNSF shipped no freight via railcar, or otherwise, to or from KPT after about 1980 (BNSF v. KPTC 2000). Freight was also shipped to and from KPT by truck.

BNSF and its predecessor companies have or are currently leasing property to lumber-processing facilities. Klingler Lumber Company appears to be operating either on top of or directly adjacent to the former pole treating area. Montana Mokko may be operating adjacent to the former pole treating area.

A number of regulatory milestone events have taken place for the former KPT wood treatment facility (DEQ 2005b), including:

- On August 16, 1980, KPT submitted first EPA Notification of Hazardous Waste Activity Form.
- On August 10, 1983, MDHES conducted an inspection of the KPT operation. No violations were noted in the Field Investigation Report; KPT operation retained listing as a small quantity generator.
- On October 1, 1986, MDHES conducted an inspection of the KPT operation. No violations were noted in the Field Investigation Report.
- On September 16, 1988, MDHES conducted an inspection of the KPT operation. The Field Investigation Report is not present in the project file.
- In 1991, the Resource Conservation and Recovery Act (RCRA) project file was closed due to KPT ceasing operations and dismantling the wood treatment facility.
- In 1994, Burlington Northern Railroad submitted a Regulated Waste Activity Form for investigation derived waste (purge water) and classified as a Class II large quantity generator. This classification was later changed to Class I large quantity generator, which is still in effect. Burlington Northern Railroad Company also began submitting annual generator reports.

A number of investigations and interim actions have been conducted at the KPT facility (DEQ 2005b), including:

- In August 1980, the KPT facility was listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).

- A 1985 CERCLA preliminary assessment by MDHES noted the potential for PCP contamination at the facility.

- A 1988 CERCLA Phase I site investigation by MDHES consultants found high levels of PCP and dioxins and furans in on-site soils and groundwater and elevated levels of some PAHs and metals, notably lead.

- A 1989 CERCLA Phase II site investigation by MDHES consultants concluded that groundwater contamination was migrating off site to the east/southeast.

- A 1991 CERCLA Phase III site investigation by MDHES consultants found no contamination in the Evergreen municipal wells or in most nearby residential wells, but found PCP in a downgradient residential well and very low levels of petroleum hydrocarbons in another downgradient irrigation well. MDHES subsequently conducted semi-annual domestic well sampling until 1998.

- In 1991, Burlington Northern Railroad, at Montana Mokko's expense, expanded the spur line to access Montana Mokko's operation. The spur line was constructed very close to, and possibly on top of, some of the worst known areas of soil contamination on the facility.

- In 1991, consultants to the EPA conducted a detailed hydrogeologic investigation to better define groundwater movement and contamination in soil and groundwater. This investigation was the result of an MDHES request for EPA emergency removal action in 1990.

- In September 1993, Montana Mokko and Klingler Lumber Company agreed to stipulation with regard to National Ambient Air Quality Standard for Particulate Matter and Montana Ambient Air Quality Standard for PM-10 after the Kalispell area was designated as a non-attainment area for particulate matter. The stipulations signed by Montana Mokko and Klingler Lumber Company (as well as MDHES) were related to the overall plan to come into compliance with the standards.

  Both parties agreed to the following requirements (among others): not cause or authorize emissions to be discharged into the outdoor atmosphere from equipment on the property, from access roads, parking lots, log decks, or the general plant property (with some specific opacity levels); to treat all unpaved portions of the haul roads, access roads, parking lots, log decks, and the general plant area with water and/or chemical dust suppressant as necessary to maintain compliance; to operate and maintain all emission control equipment; and to submit an annual emission inventory to MDHES Air Quality Bureau for the listed emission points.

- In 1992, consultants for a potential buyer of a property south of Highway 2 conducted a Phase I and II environmental site assessment to evaluate whether the property was affected by contamination from the three nearby Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) sites. Petroleum hydrocarbons and low levels of several PAHs were found in soil and groundwater on the property, but the source of contamination had not been identified. Several potential sources were noted to exist in the area.

- In 1994, MDHES consultants prepared a draft HRS package for the KPT and Reliance facilities. An evaluation of the facilities indicated that both facilities (in combination) were candidates for the NPL. The facilities were never actually proposed for listing, but the HRS package was prepared.

- In 1994, Burlington Northern Railroad consultants completed an investigation at the site to confirm the results of previous investigations, replace damaged monitoring wells, and collect additional data. Free product or a petroleum sheen was detected in most of the monitoring wells during most sampling events. The free product was generally less than 1 foot thick. A plume of dissolved PCP and dioxins and furans was also found.

- In 1995, DEQ noticed BNSF, KPT, and Montana Mokko as potentially liable persons (PLP) for the KPT facility.
- In 1995, BNSF canceled the lease of the potato warehouse and stated plans to remove the building. The warehouse was torn down between mid-1995 and 1998. The Site Investigation Report for KPT, prepared by Remediation Technologies, Inc. (RETEC) in July 1995, presents figures depicting the location of the potato warehouse. The Supplemental Remedial Investigation Report for KPT, prepared by RETEC in February 1998, presents figures depicting the location of the former potato warehouse.
- In the mid-1990s, a small building located on the state-owned portion of the KPT facility was removed. This building was located in the eastern portion of the property adjacent to Flathead Drive. The building is visible on the 1995 aerial photograph of the area. The building is not present on the 2004 aerial photograph. It appears the building was part of the oil refinery since the building is depicted and labeled on the 1950 and 1963 Sanborn Fire Insurance Maps for the Unity Petroleum Corporation refinery.
- In 1996, BNSF consultants began additional site investigations to delineate the contaminant plumes of PCP and nonaqueous phase liquids (NAPL). The BNSF consultants installed five new monitoring wells and began a pilot air-sparging program. Sampling of local domestic wells by DEQ found PCP and petroleum contamination for the first time since the 1991 sampling event.
- In 1997, BNSF connected one local residence to the city water system.
- In 1997 and 1998, BNSF consultants conducted a supplemental RI. The purpose of this investigation was to fill data gaps identified during the investigation in 1994 and 1995; delineate the downgradient extent of the plume of dissolved PCP; characterize the western edge of light nonaqueous phase liquid (LNAPL) contamination; calculate the direction of groundwater flow in the northern portion of the site; calculate groundwater velocity during low-water periods, and assess the extent of surface PCP contamination in soil.
- In April 1999, a one-time soil excavation was conducted to remove PCP hot spots in shallow soils and transport them off site for disposal in a Subtitle C facility. This action occurred before the Phase IV Land Disposal Restrictions were promulgated that prohibited F032-contaminated soils and debris from land disposal. F032 is a RCRA hazardous waste designation for wastes from some wood preserving processes (40 Code of Federal Regulations Section 261.31). BNSF consultants excavated approximately 470 cubic yards of contaminated soils from the former treatment area located at the facility. The contaminated soils were transported to and disposed at Chemical Waste Management of the Northwest, Waste Management Industrial Services' Subtitle C landfill located in Arlington, Oregon.
- In December 1998, proper and expeditious (P&E) letters were sent, pursuant to Montana Code Annotated § 75-10-711(3), to the PLPs who had received the notice letter asking them to undertake the work necessary at the KPT facility. At this time, the noticed parties for the KPT facility included BNSF, KPT, and Montana Mokko.

- In 2001, BNSF resumed sampling of groundwater monitoring wells associated with the facility to further define the magnitude and extent of contamination associated with the KPT facility. Samples were analyzed for PCP, extractable petroleum hydrocarbons, semivolatile organic compounds (SVOC), and dioxins and furans. BNSF consultants have conducted semi-annual groundwater sampling since 2001.
- In November 2001, DEQ noticed Klingler Lumber Company, Swank Enterprises, and the Montana Department of Natural Resources and Conservation (DNRC) as PLPs for the KPT facility.
- In 2004, BNSF upgraded the ozonation system (originally installed in 1999 as a pilot-scale system) to be a full-scale system without DEQ approval or oversight. DEQ reviewed and commented on the "as-built" report in April 2005.
- In July 2004, DEQ filed a lawsuit naming the noticed PLPs as defendants. In the lawsuit, DEQ requests reimbursement of its oversight costs and a court order requiring the defendants to conduct remedial actions. DEQ's CECRA program is acting as the lead agency for the facility and has ranked it a high priority.

A detailed summary of these investigations and interim actions is presented in Section 2.3.

2.2.2 Reliance Refinery Company Facility

Reliance is a former oil refinery that operated from 1924 to the 1960s. The facility encompasses approximately 7 acres. On-site disposal of sludge, leaks of sludge and oil from aboveground storage tanks, and off-loading of crude oil contaminated soil with petroleum hydrocarbons and some metals, notably lead. Groundwater beneath the Reliance facility is contaminated with petroleum hydrocarbons, PCP, and PAHs.

The Reliance Refining Company was incorporated on November 14, 1923, after oil was discovered in the Kevin-Sunburst fields in north-central Montana in October 1923. The Reliance Refining Company owned and operated the refinery from 1924 to 1930. A fractionating oil refinery was constructed in about 9 months, and refining operations started by November 1924. By November 1925, the refinery was producing 20,000 gallons of gasoline daily (HRA 1995). The refinery also produced kerosene, jet fuel, distillates, gas oil (diesel engine oil), transmission oil, floor oil, and other petroleum byproducts. The crude oil and petroleum products were stored in aboveground storage tanks and earthen dikes/barrow pits. In 1929, a cracking plant was installed at the facility (EPA FIT 1986a, EPA 1992a).

The refinery property was sold for back taxes to the State of Montana at a public auction held on November 21, 1930; the final deed was issued on December 26, 1935. Boris Aronow, doing business as

Unity Petroleum Corporation, leased the property from the state on December 5, 1930. The lease expired on November 26, 1935. The Reliance Refining Company was sold to Boris Aronow in February 1932. The Unity Petroleum Corporation was incorporated in March 1933. The Unity Petroleum Corporation leased and operated the property from 1935 until 1969.

There are conflicting reports on the length of time the refinery operated at the facility. Unity Petroleum Corporation was listed in the Kalispell city directories between 1928 and 1944. However, there were no listings in the city directories between 1945 and 1956. The last two listings for Unity Petroleum were in 1957 and 1959. These two listings identified Tony Schumacher as a bookkeeper for Unity Petroleum (HRA 1995). Mr. Aronow reported that bulk storage operations continued at the site into the 1960s (State Board of Land Commissioners 1962). There are listings in the city directories from 1962 through 1969 for Schumacher's Evergreen Fuel Company. The 1963 Sanborn map contains a note that the oil refinery was no longer in operation and that only one person was working at the facility. The refinery was dismantled in 1970 (EPA FIT 1986a, EPA 1992a). The state involuntarily dissolved the Unity Petroleum Corporation in 1982 for failure to provide annual reports and fees (HRA 1995).

The State of Montana leased the property to KPT on August 13, 1969; the lease was terminated on January 28, 1994 (Pioneer Technical Services [PTS] 2000). KPT leased the property for storage of poles. In 1973, KPT requested permission from MDHES to cover an aboveground storage tank with wood chips. The tank, which contained 16 inches of tar, had been cut off near the floor, leaving the bottom and lower sidewalls of the tank in place. MDHES granted KPT permission (DEQ 1973), and the tank bottom was covered with wood chips (EPA FIT 1986a).

The southern portion of the facility was used to store poles. KPT personnel have claimed that butt dipping occurred at the Reliance Facility as a one-man operation. KPT personnel said that this technique was used sometime between 1968 and 1973 and lasted only 3 to 4 years. The treatment included cold soaking poles in drums of treatment fluid (DNRC 1988). In 1988, the EPA constructed a security fence around the southern portion of the facility. The fenced area is located on the state-owned portion of the facility. The EPA also fenced a small area northeast of the facility and adjacent to (east of) the railroad tracks. The fences were constructed based on reports of children playing in sludge pits at those locations. KPT conducted operations on the property until May 1990. The KPT board of directors approved the dissolution of the corporation as of December 31, 1990. KPT was involuntarily dissolved by the state on December 6, 1991.

A number of investigations and interim actions have been conducted at the Reliance facility (DEQ 2005b), including:

- In January 1985, the Reliance facility was listed on CERCLIS.
- A 1985 CERCLA preliminary assessment by MDHES noted the potential for contamination at the facility.
- A 1986 CERCLA initial investigation by EPA contractors found dioxins in on-site soils.
- In 1988, the EPA Emergency Removal Branch constructed a security fence around a portion of the facility and posted hazard warning signs based on reports that children were playing in the sludge pits.
- A 1988 CERCLA Phase I site investigation by MDHES consultants revealed high levels of total petroleum hydrocarbons, metals (primarily lead),and PAHs, and low levels of dioxins at the Reliance facility. PCP was found in one soil sample and in groundwater.
- A 1989 CERCLA Phase II site investigation by MDHES consultants concluded that groundwater contamination was migrating off site and to the east/southeast.
- A 1991 CERCLA Phase III site investigation by MDHES consultants found no contamination in the Evergreen municipal wells or in most nearby residential wells, but found PCP in a downgradient residential well and very low levels of petroleum hydrocarbons in another downgradient irrigation well. MDHES subsequently sampled domestic wells semi-annually until 1998.
- In 1992, consultants for a potential buyer of a property south of Highway 2 conducted a Phase I and II environmental assessment to evaluate whether the property was affected by contamination from the three nearby CECRA sites. Petroleum hydrocarbons and low levels of several PAHs were found in soil and groundwater on the property, but the contaminant source had not been identified. Several potential sources were noted to exist in the area.
- In 1994, MDHES consultants removed barrels of contaminated purge water and drill cuttings, which had been stored inside the fence at the Reliance site. The water and cuttings were from past investigations at the Reliance, KPT, and Yale Oil facilities.
- In 1994, MDHES consultants prepared a draft HRS package for the KPT and Reliance facilities. An evaluation of the facilities indicated that both facilities (in combination) were candidates for the NPL. The facilities were never actually proposed for listing, but the HRS package was prepared.
- In 1995, DEQ noticed BNSF, Klingler Lumber Company, and Swank Enterprises as PLPs for the Reliance facility.
- In 1996 and 1997, DNRC applied for and received two grants for preparation and submittal of a Voluntary Cleanup Plan for removing, treating, and recycling approximately 20,000 cubic yards of petroleum contaminated soils in an asphalt batch plant with the end product used for highway construction.
- In 1996, DEQ consultants completed a draft RI for a portion of the facility. The RI was finalized as a Phase I RI report in December 2000. A Final Draft Feasibility Study (FS) Report was prepared in December 1997.

- In February 2000, DNRC submitted a report detailing the preliminary screening of remedial alternatives for the facility. The report represented potential interim actions to address contaminants in soils on the state-owned portion of the facility. DEQ was unable to approve the document because the interim actions proposed were not consistent with final cleanup.
- In October 2000, and pursuant to Montana Code Annotated § 75-10-711(3), P&E letters were sent to the noticed PLPs asking them to undertake the work necessary at the Reliance facility. At the time, the parties who received notice for the Reliance facility included BNSF, Klingler Lumber Company, and Swank Enterprises.
- In October 2000, BNSF requested that DNRC be noticed as a PLP for the Reliance facility. In 2001, DNRC requested that it be noticed as a PLP for the Reliance facility.
- In November 2001, notice letters were also sent to McElroy and Wilken, Inc., and to DNRC, identifying them as PLPs for the Reliance facility. When the company received the notice letter, McElroy and Wilken, Inc. characterized its portion of the facility to further evaluate the presence of contamination. Activities included installation of two groundwater monitoring wells and collection of soil samples. Soil and groundwater samples were evaluated for PCP, total petroleum hydrocarbons, and dioxins. McElroy and Wilken, Inc. established a subsurface migration exclusion as a result of the additional investigations.
- In 2002, DNRC conducted an interim investigation at the facility to address specific data gaps and to initiate groundwater remediation. Two free-phase recovery wells were installed, and recovery of free product began in July 2002. Additional soil samples were collected to further characterize contamination in soil across the facility. Routine groundwater monitoring was also initiated and was conducted in conjunction with monitoring for the adjacent KPT facility. DNRC submitted a Phase II RI/FS to DEQ in December 2002.
- In October 2002, Klingler Lumber Company was removed from the PLP list for the Reliance facility after it provided information indicating it had never owned property at Reliance.
- In July 2004, DEQ filed a lawsuit naming the PLPs who had received notice letters as defendants (except McElroy & Wilken and Klingler, who were previously removed from the PLP list). In the lawsuit, DEQ requests reimbursement of its oversight costs and a court order to require the defendants to conduct remedial actions. DEQ's CECRA program is acting as the lead agency for the facility and has ranked it a high priority.

A detailed summary of these investigations and interim actions is presented in Section 2.3.

2.2.3 Yale Oil Corporation Facility

The Yale Oil Facility is a former petroleum bulk plant and product refinery that operated from 1938 to 1978. The facility encompasses approximately 2.3 acres. Leaks and possible spills from aboveground storage tanks contaminated on-site soils. Thermal desorption, using a permitted unit, was conducted on the soils to remove petroleum hydrocarbon contamination. However, groundwater beneath the facility is contaminated with PCP, dioxins and furans, and petroleum hydrocarbons.

Yale Oil Corporation developed the property for use as a refinery and bulk plant in the 1930s. The first evidence that Yale Oil had established a business in Kalispell appears in the 1936 city directory (HRA 1995). The facility refined crude oil from the Kevin-Sunburst oil fields in north-central Montana, which were developed in 1923. Crude oil was delivered to the facility by truck and rail. The refinery has been described as a small operation with a daily capacity of 500 barrels. Tractor fuel (similar to diesel) and fuel oil were the primary products of the refinery. Crude oil and petroleum products were stored in aboveground storage tanks.

Yale Oil Corporation owned and operated the facility until 1944, when the property was sold to Carter Oil Company. Refining operations at the facility ceased shortly after. Facility features present on the 1927 Sanborn map are labeled as “not used” on the 1950 Sanborn Map. As early as 1945, Carter Oil leased the property to the T.J. Landry Oil Company, Inc., a petroleum products distributorship. Mr. Landry ran the distributorship until he turned over management of the operation to his son-in-law, Bill Roberts. Mr. Roberts managed the distributorship until 1978 (Applied Earth Sciences, Inc [AES] 1986a).

On December 15, 1959, Carter Oil, along with Esso Standard Oil, merged with Humble Oil and Refining Company. Humble Oil merged with Exxon Corporation on December 26, 1972. In February 1978, the bulk plant operations at the site were closed. The product inventory and all storage tanks, except the No. 5 fuel oil tank, were purchased by City Service Center and then moved to its property south of Kalispell.

In February 1980, Exxon Corporation granted the property to the Exxon Education Foundation. The property was sold to the National Development Corporation in December 1981. In 1982, the Pacific Iron and Steel Division of Pacific Hide & Fur dismantled the No. 5 fuel oil tank. The No. 5 fuel oil tank was cut off near ground level, leaving the tank bottom and lower sidewalls in place. Any product, sludge, or tank bottom that remained in the tank was left in place (AES 1986a). In October 1983, property ownership reverted to the Exxon Education Foundation and subsequently to Exxon Corporation in November 1988. The current property owner is Kalispell Partners LLC, and a commercial business currently exists on the facility.

A number of investigations and interim actions have been conducted at the Yale Oil Facility (DEQ 2005b), including:

- In January 1985, the Yale Oil facility was listed on CERCLIS.
- In 1985, petroleum product in the No. 5 fuel oil tank bottom left on-site spilled onto the ground. Follow-up site investigations were conducted by EPA and Exxon Corporation.
- In 1986, MDHES completed a CERCLA preliminary assessment.
- In February and March of 1986, EPA consultants and MDHES conducted a CERCLA site investigation to characterize the nature of groundwater contamination associated with the facility and to characterize waste materials found in the sludge and contaminated soils. Sample results indicated high concentrations of PAHs and phenols in on-site soils and sludges and contamination of the on-site shallow alluvial groundwater with phenols and petroleum hydrocarbons. PCP was detected in a background monitoring well and may have originated from another source. Lead and zinc were detected at elevated concentrations in an on-site soil sample. Split samples were collected by Exxon's consultant.
- In June 1986, a follow-up sampling event was conducted by EPA consultants and MDHES to identify and characterize the potential for dioxin contamination in soils and waste material and determine the potential for direct contact with contamination. However, the data from this sampling event was not reported. Exxon's consultant collected split samples and reported detectable concentrations of dioxin and furan compounds in soil samples.
- In June 1989, MDHES consultants completed a site inspection decision sheet, which identified the waste type at the facility as a non-hazardous substance and the nature of the release as observed but below the HRS release threshold. The facility was determined to be "No Further Remedial Action Planned" under CERCLA.
- In 1989, Exxon consultants prepared a remediation plan and conducted a test burn to determine the safety and effectiveness of using thermal desorption on contaminated soils at the facility.
- In August 1993, DEQ noticed Exxon Corporation as a PLP for the facility.
- In June 1993, EPA consultants conducted a CERCLA site inspection prioritization to review existing data and identify whether data gaps exist with regard to HRS scoring and to provide sufficient documentation for a determination of potential human health and environmental impacts.
- In 1993, Exxon conducted a voluntary cleanup action consisting of removing the tank bottom and the sludges within the tank bottom; plus the contaminated soils associated with the tank bottom. Piping and stained soils associated with the piping were also excavated and thermally desorbed. Over 200 cubic yards of soil was not thermally desorbed because the TPH concentrations were above 1,300 ppm, which was the maximum level allowed for thermal desorption by the DEQ-issued permit. These soils were stockpiled on-site.
- In 1994 and 1995, Exxon consultants conducted quarterly groundwater monitoring of facility wells. Samples were analyzed for gasoline and diesel-range organic compounds, phenols, and SVOCs. Phenols were detected in samples from monitoring wells on the facility.
- In 1997, the soils that were stockpiled in 1993 were removed to an unknown disposal facility. Confirmation samples taken from the area where the stockpiled soils were stored showed 423

ppm diesel range organics (DRO), which was above the DEQ-established cleanup level for the site of 100 ppm. There is no information in the file to determine if the soils were ever excavated and/or disposed at an approved facility.

- In August 1997, DEQ entered into a prospective purchaser agreement with Kalispell Partners and later voided it because of numerous violations on the part of Kalispell Partners.
- In April 1998, DEQ entered into a Settlement Agreement with Kalispell Partners.
- In November 2000 and May 2002, Exxon consultants conducted groundwater monitoring of facility wells. Samples were analyzed for EPH and VPH constituents. Some EPH and VPH constituents were detected above screening levels.
- In July 2004, DEQ filed a lawsuit naming the noticed PLP as a defendant. In the lawsuit, DEQ requested reimbursement of its oversight costs and a court order requiring the defendants to conduct remedial actions. DEQ's CECRA program is acting as the lead agency for the facility and has ranked it a medium priority.

A detailed summary of these investigations and interim actions is presented in Section 2.3. Also presented in this section is a summary of investigations conducted of properties near the Yale Oil facility. The Rocky Mountain Marine property is adjacent to the southern boundary of the facility. The Wal-Mart and Seaman/Shelton properties are located east of the facility and Highway 2.

2.3 SUMMARY OF INVESTIGATIONS AND INTERIM ACTIONS

Previous and ongoing investigations and interim actions at and in the vicinity of the KRY site are presented in chronological order and summarized below. The investigating entity, the date of the report or investigation, and the facility being investigated are provided for reference for each entry. A summary of investigations and interim actions presented in this section is provided in Table 2-3. Sampling results from these investigations are summarized in Section 4 and Appendix D.

2.3.1 Investigations Conducted in Calendar Year 1985

<u>DEQ (formerly MDHES), Report Dated: July 17, 1985 – KPT</u>

A preliminary assessment (PA) was written for the KPT facility in July 1985 based on a site visit conducted by DEQ personnel on August 10, 1983. The PA outlined the potential for PCP contamination at the facility.

DEQ, Report Dated: October 30, 1985 – Reliance

DEQ's Solid and Hazardous Waste Division carried out a site investigation of the Reliance property in October 1985. The purpose of the investigation was to delineate the extent of tar pits or boils on the former refinery site. The largest tar pit was discovered near the junction of a spur line and the main railroad tracks on the northern end of the property. A second tar pit was found on the eastern side of the main north-south railroad track, north of the State Lands property. Eight soil test pits were dug near the tar pits at depths ranging from 2 to 6 feet. Two soil samples were collected: one from 5 feet below ground surface (bgs), and the other from the surface of a tar pit (DEQ 1985). The samples were analyzed for total metals; however, no metals data currently appear in the database because no laboratory reports were found in DEQ files.

Applied Earth Sciences, Inc. (AES), Report Dated: October 14, 1985 – Yale Oil

In July 1985, AES was asked to investigate the possibility of soil contamination from a spill site at the former Yale Oil facility on behalf of the Exxon Company, U.S.A. The spill site was located at the remains of an abandoned, aboveground storage tank. The purpose of the investigation was to define the extent and chemical nature of oil visible on the surface, to evaluate whether oil had migrated into the groundwater, and to develop a remedial action plan for the site. A total of 14 monitoring wells were identified on the Yale Oil facility for the investigation. Four observation wells (MW-1 through MW-4) were installed in August 1985. An existing well within the boundaries of the Yale Oil property was labeled W-5, and an operating well located in the Town and Country Trailer Court (approximately 270 feet south of the abandoned storage tank) was labeled W-6. In September 1985, eight additional wells (MW-7 through MW-14) were installed on both Yale Oil and the adjoining property, owned by Rocky Mountain Marine to the south. Wells MW-7, MW-8, MW-9, and MW-11 were constructed on the property of Rocky Mountain Marine. All wells were completed in the shallow unconfined aquifer no deeper than 30 feet bgs.

In total, 29 samples were collected from the Yale Oil property during the AES 1985 investigation. Ten samples were sent to Rocky Mountain Analytical Laboratory (five water samples from wells MW-2, MW-3, MW-4, W-5, and W-6, four soil samples from each well boring for wells MW-1 through MW-4, and one sludge sample assumed to be collected from the old tank bottom). Nineteen samples were sent to EA Engineering for SVOC and volatile organic compounds (VOC) analysis. Samples included one background sample, two source material samples (one product sample from the tank on the Yale Oil property and one sample of product on the surface at the former Reliance facility), one product sample collected from the surface of the water table at monitoring well MW-4, five water samples (MW-1, MW-4, MW-12, MW-13, and MW-14), and 10 soil samples from well borings (MW-12 and MW-13, from a depth of 16 feet bgs; MW-7, MW-9, MW-11, MW-12, and MW-13 collected at a depth of 20 feet bgs; MW-14 from a depth of 21 feet bgs; and MW-8, and MW-10 from a depth of 23 feet bgs).

2.3.2 Investigations Conducted in Calendar Year 1986

<u>AES, Report Dated: May 14, 1986 – Yale Oil</u>

AES continued its investigation of the Yale Oil facility for the Exxon Company in February 1986. This investigation was aimed at determining if the product remaining in the abandoned tank bottom and the surrounding surface soil was hazardous. To make this determination, three samples of product were collected, two from within the tank bottom and one from the ground surface outside the tank. Only two of the three product samples were analyzed. Three monitoring wells, MW-15 through MW-17, were installed around the remains of the tank bottom, but the wells were never developed and no water samples or water level measurements were ever taken. The well borings were advanced to access the soils with depth around the tank bottom. Soil samples were collected every 5 feet or more if the soil type changed. In total, 13 soil samples were collected from boreholes as drilling advanced: three from monitoring well MW-15, six from well MW-16, and four from well MW-17. Of these, only six were analyzed (MW-15 – 5 and 15 feet bgs, MW-16 – 5 and 18 feet bgs, and MW-17 – 5 and 12 feet bgs). Samples were analyzed for metals, cyanides, and phenols; pesticides; polychlorinated biphenyls (PCB); SVOC; and VOC (AES 1986a).

<u>EPA Field Investigation Team (FIT) Reports Dated: May 6, 1986 and July 31, 1986 – Yale Oil</u>

In February and March 1986, the EPA FIT conducted a field investigation to characterize the nature of groundwater contamination and waste materials found in sludge and contaminated soils on the Yale Oil property. Groundwater samples were collected from five monitoring wells AES had previously installed in 1985. Water samples were collected at monitoring well locations YR-GW-1 (AES well MW-12), YR-GW-2 (AES well MW-4), YR-GW-3 (AES well MW-3), YR-GW-4 (AES well MW-1), and YR-GW-5 (AES well MW-9). Two shallow soil samples were collected on the Yale Oil facility. A third soil sample was collected from the Montana Power Company (currently Northwest Energy) property. One sludge sample was obtained from the southern edge of the abandoned tank bottom on the Yale Oil property (EPA

FIT 1986b). All samples were analyzed for VOC, SVOC, and total metals. EPA directed the FIT to undertake an additional investigation of the Yale Oil facility in June 1986.

EPA FIT Report Dated: August 5, 1986 – Yale Oil

On June 30, 1986, the EPA FIT collected samples to characterize potential dioxin contamination and the potential for contact with contaminants at the Yale Oil facility. Three surface soil samples (YR-SO-2A, YR-SO-5, and YR-SO-6) were collected at depths from 0 to 3 inches bgs and sent for dioxin analysis. Sample YR-SO-2A was collected underneath the bulk tanks area at the old site; YR-SO-5 was collected in a stained area between the old abandoned tank bottom and a small tree adjacent to the south side of the tank bottom; and YR-SO-6 was collected in a field about half-way between monitoring well MW-4 and the corner of the site's fenced enclosure. One sludge sample (YR-SL-1A) was collected directly from the old abandoned tank bottom inside the fenced area of this site. One soil sample, RR-SO-8, was collected approximately 3,000 feet due west from the Yale Oil facility in the Stillwater River flood plain and was collected to serve as the background soil sample for both the Yale Oil and Reliance facilities during the 1986 investigations (AES, 1986b). One rinsate and one performance check sample were also collected (EPA FIT 1986d). All samples collected by EPA FIT were split with representatives of AES.

AES Report Dated: September 17, 1986 – Yale Oil

This report discusses the sampling event that occurred on June 30, 1986, by EPA FIT and addresses questions DEQ raised about the remedial action plan originally proposed by AES on behalf of Exxon on May 14, 1986 (AES 1986b).

EPA FIT, Reports Dated: April 15, 1986 & July 22, 1986 – Reliance

In February 1986, the EPA FIT conducted a field investigation at the Reliance facility (concurrent to the investigation carried out at the Yale Oil facility during this time period). Three monitoring wells were installed: RR-MW-1 was installed in the northwestern portion of the site 300 feet north of the railroad spur, RR-MW-2 was installed on the southern portion of the property (south of the former refinery location), and RR-MW-3 was constructed on the eastern side of the property (EPA FIT 1986a). An electromagnetic conductivity survey was performed to identify the locations of buried tanks and delineate clay-rich areas in a buried channel.

Seven groundwater samples were collected, one from each of the three monitoring wells, two from existing wells (RR-GW-1 and RR-GW-2), and two as quality assurance (QA) samples. RR-GW-1, a residential well north of the Reliance property, and RR-GW-2, a municipal supply well northeast of the property at the Evergreen trailer court, were used to obtain two background water samples. Three core soil samples, RR-SO-1 through RR-SO-3, were collected when the wells were drilled. A fourth soil sample, RR-SO-4, was collected as a background sample northwest of the site, on the western side of the driveway for the Roland residence. Two sludge samples were also obtained from the property. Sludge sample RR-SL-1 was collected 57.5 feet southeast of monitoring well RR-MW-3 and 38 feet west of the BNSF railroad tracks. Sludge sample RR-SL-2 was collected from the tank bottom identified by the geophysical survey (EPA FIT 1986a). Samples were analyzed for SVOC, VOC, pesticides, and metals. EPA directed the FIT to undertake an additional investigation of the Reliance facility in June 1986.

<u>EPA FIT, Reports Dated: August 4, 1986 & October 21, 1986 – Reliance</u>

Concurrent with sampling at the Yale Oil facility on June 30, 1986, the EPA FIT collected samples to identify and characterize the potential for dioxin contamination in soils and tank bottom sludge and to evaluate the potential for direct contact with contaminants at the Reliance facility. Four surface soil samples were collected: RR-SO-5 was collected in the west-center of the site; RR-SO-6 was collected next to a railroad track spur near the center of the property about 1 to 2 feet from a tar seep; RR-SO-7 was collected in the southeastern corner of the property in a grassy area; and RR-SO-8, the background soil sample, was collected from the Stillwater River flood plain. Five sludge samples were collected from the following locations: RR-SL-1A and RR-SL-2A were obtained from the same locations as the two sludge samples collected in February and March of 1986; RR-SL-4 and RR-SL-6 were collected at the junction of the railroad spur with the main line (RR-SL-6 was a duplicate of RR-SL-4); and RR-SL-5 was collected from a ditch north of the junction between the railroad spur and the main line (EPA FIT 1986c).

2.3.3 Investigations Conducted in Calendar Year 1988

<u>MSE Inc. (MSE), Report Dated: June 30, 1989 – Reliance / KPT</u>

MSE, Inc., performed a site investigation at the KPT and Reliance facilities in 1988 for DEQ. The objectives of the site investigation were to characterize the soil through sampling efforts, to define the contaminants within the on-site sludge, and to evaluate potential impacts to groundwater from wood treating or the refinery. Three monitoring wells were drilled and installed at the KPT facility. Well GW-

1 was installed in the northwestern section of the KPT property, and monitoring well GW-2 was installed on the southwestern corner of the KPT property. Well GW-3 was constructed east of the KPT property and approximately 100 feet west of Flathead Drive (Flathead Drive is the surface dividing line for the KPT and Reliance facilities)(MSE 1989). Five groundwater samples were collected from KPT (one from each installed monitoring well, one duplicate sample from monitoring well GW-2, and an equipment rinsate sample), two were collected from the Reliance property (from monitoring wells RR-MW-2 and RR-MW-1), and one was collected from the Yale Oil facility from monitoring well MW-12. Six soil samples (two at the KPT facility, three at the Reliance facility, and one background) were collected as well. The background soil sample was taken from a residential yard on the corner of Flathead Drive (due to its location immediately adjacent to the KPT facility, this soil sample is probably not representative of true background conditions). One sludge sample was collected from the Reliance facility; it was obtained from an old buried drum that was adjacent to a large tank bottom at the southern end of the fenced area. All samples were analyzed for VOC, SVOC, metals, and dioxin (MSE 1989).

2.3.4 Investigations Conducted in Calendar Year 1989

<u>MSE, Report Dated: June 1990 – KPT / Yale Oil / Reliance</u>

MSE, Inc., on behalf of DEQ, collected additional samples at the KPT facility to evaluate whether the site should be included on the National Priorities List via Hazard Ranking System scoring. The major focus was to further define groundwater contamination at the KPT facility, as well as at the Reliance and Yale Oil facilities. Two new monitoring wells (GW-4 and GW-5) were installed on the KPT property in December 1989. The deep well, GW-4 (135 feet bgs), was installed in the north-central portion of the KPT property, north of the BNSF railroad spur line. In drilling well GW-4, the upper portion of the aquitard (as referred to in the MSE report) was detected at 120 feet and consisted of fine sand, silt, and clay to a depth of 135 feet. The shallow well, GW-5 (26 feet bgs), was constructed on the southeastern corner of the KPT property near the intersection of Montclair Drive and Flathead Drive. Nine groundwater samples were collected in December 1989. Four samples were from existing monitoring wells on the Yale Oil property (MW-4, MW-12, MW-13, and MW-14) and two were from the new monitoring wells constructed on the KPT property (GW-4 and GW-5). Groundwater samples were analyzed for SVOC and VOC. All existing monitoring wells on the KPT, Reliance, and Yale Oil (KRY) sites were surveyed for locations and elevations. The survey was tied to a U.S. Geological Survey (USGS) benchmark near Highway 2 and the railroad tracks (MSE 1990). In addition, water levels were measured in each well to create an accurate groundwater surface map and to better calculate the direction of groundwater flow. As a result, five wells on the KPT property, 11 wells at the Yale Oil facility, and three at the Reliance facility were surveyed and measured (MSE 1990).

2.3.5 Investigations Conducted in Calendar Year 1991

MSE, Report Dated: October 1991 – KPT

MSE, Inc. conducted a site investigation at the KPT facility for DEQ in June 1991. The purpose of this site investigation was to evaluate whether contamination from the former KPT facility had migrated through groundwater to drinking water supplies. Three monitoring wells on the property formerly occupied by the Kalispell Pole & Timber Company were sampled: MW-3, MW-4, and MW-5. Nine residential wells were also sampled as part of this investigation. Four of the wells were northeast of the KPT facility, five were east of the KPT facility, and one was southeast of KPT. The well to the southeast emitted a distinct petroleum odor. A sample was also collected from the Evergreen Water District Well #1 (northeast of KPT). Samples were analyzed for phenols, PAH, and TPH (1 sample only; RW-5). The potential presence of a denser than water, nonaqueous phase liquid (DNAPL) in well GW-4 was also investigated by selectively sampling at depth at the bottom of the well, but analytical results confirmed there was no DNAPL in the well (MSE 1991).

Roy F. Weston Inc. for EPA, Report Dated: February 1992 – KPT / Reliance

The EPA Environmental Response Team requested that Roy F. Weston Consultants study the extent of contamination at the KPT and Reliance facilities in July 1991. The study was conducted in three phases. In the first phase, 12 surface soil samples were collected from the KPT property and five surface soil samples were collected from the Reliance property. In the second phase, 12 monitoring wells were sampled (five on the KPT facility: GW-1 through GW-5, three at the Reliance facility: GWRR-1 through GWRR-3, and four at the Yale Oil facility: GWY-8, 10, 12, and 14). Additionally, a terrain conductivity test was performed, and water table elevations were measured in all of the monitoring wells. In the third phase, a trackhoe was used to excavate 15 trenches and nine test pits within the KPT property (PTS 2000). Eighty-five subsurface soil samples were collected from the excavation, as well as 12 subsurface composite samples. Additionally, 29 samples (assumed to be surface to 6 inches bgs) were collected from the KPT facility, and seven surface soil samples were collected at the Reliance facility. In total, 133 soil samples were collected: 53 discrete surface samples, 85 subsurface samples, and 12 subsurface composite samples. Samples were analyzed for dioxins and furans, metals, TPH, SVOC, and VOC (Weston 1992).

NTL Engineering and Geoscience, Inc. (NTL), Report Dated: October 1991 – Wal-Mart

NTL performed a Phase I Environmental Site Assessment (ESA) in 1991 on an adjacent property to Yale Oil (east side of Highway 2) for Civil Land Consultants of Englewood, Colorado in reference to the proposed development of a Wal-Mart shopping center. At the time the ESA was conducted, the site consisted of three tracts of land owned by Patty and Vernon Seaman and encompassed approximately 18 acres. The site assessment involved interviewing current property owners, area business owners, and state and local officials about activities on the property or surrounding properties that may have had environmental impacts on the site. Based on the results of the historical review, NTL determined that there had been no apparent site usage in the past that would have created a potential for soil or groundwater contamination. However, based on the presence of three contaminated properties to the northwest (Yale Oil, Reliance, and KPT) and general direction of groundwater flow — believed to be east to southeast — NTL recommended that a Phase II ESA be conducted to evaluate whether the property had been affected by these neighboring facilities (NTL 1991a).

NTL, Report Dated: October 25, 1991 – Wal-Mart

NTL conducted a geotechnical investigation of the Wal-Mart property in 1991 for Civil Land Consultants of Englewood, Colorado to obtain sufficient subsurface data to support an engineering analysis for design and construction of the Wal-Mart retail store. Eleven test borings were drilled in the proposed building area to depths ranging from 17.5 to 23.4 feet bgs. Seventeen borings (4.0 to 10.5 feet bgs) and two test pits (2.8 to 3.5 feet bgs) were excavated in the proposed parking and access roadways areas. Observation wells were installed in borings DH-4, DH-5, DH-8, and DH-202. Approximately 128 soil samples were collected during excavation of the borings for analysis of engineering-related characteristics (soil moisture, density, compression, and resistivity)(NTL 1991b).

2.3.6 Investigations Conducted in Calendar Years 1992—1993

NTL, Report Dated: February 1992 – Wal-Mart

NTL completed a Phase II ESA in 1992 of the proposed Wal-Mart retail development for Civil Land Consultants of Englewood, Colorado. The purpose of the site assessment was to evaluate whether subsurface soil or groundwater had been contaminated by upgradient sources of petroleum hydrocarbons and contaminants, calculate the general direction of groundwater flow, and discuss possible actions if contaminants were discovered. Four borings (EH-1 through EH-4) were drilled on the site in January 1992 and four subsurface soil samples were collected (EH-1, 2.5-4.5 ft bgs; EH-2, 7.5-11.5 ft bgs; EH-3, 12.5-14.5 ft bgs; and EH-4, 17.5-19.5 ft bgs). Monitoring wells were installed in borings EH-1, EH-2, and EH-3, and groundwater samples were collected from each of the new wells. A groundwater sample was also retrieved from a residential well, RW-1 (Seaman residential well), located in the southern portion of the property. Both groundwater and soil samples were analyzed for TPH and SVOC. Groundwater level measurements were retrieved from the three new wells, the residential well, and from four observation wells installed by NTL in September 1991 (NTL 1992).

Spratt and Associates, Consulting Hydrogeology, Report Dated: August 24, 1992 – Wal-Mart

Spratt and Associates performed a Phase III ESA in 1992 of the Seaman property for Patty Shelton of Seaman Mobile Homes (proposed site for the Wal-Mart retail development). The focus of the site assessment was to better define the direction of groundwater flow, resolve inconsistencies detected among previous reports, and to delineate the extent of the contamination. Three borings were constructed and sampled (soil samples were analyzed for gasoline range organics [GRO] and benzene, toluene, ethyl benzene, and total xylenes [BTEX]) and then completed as monitoring wells SW-5, SW-6, and SW-7. The wells were installed to depths greater than the monitoring wells that already existed on the property. Groundwater samples were collected at these three new wells and at wells MW-14 and EH-1. Twenty additional borings were also constructed to assess the contaminants at wells EH-1 and EH-2. Five of the borings (SW-8, SW-9, SW-10, SW-11, and SW-12) near EH-1 were completed as monitoring wells. Groundwater samples were analyzed for SVOC. All wells on the Seaman property (including those from prior investigations) were resurveyed to measure wellhead elevations to a common USGS benchmark (Spratt and Associates 1992).

Spratt and Associates, Consulting Hydrogeology, Report Dated: March 29, 1993 – Wal-Mart

Spratt and Associates, on behalf of Patty Shelton of Seaman Mobile Homes, completed an initial site assessment of the Larsen property (north of the Seaman property and adjacent to Yale Oil on the east side of Highway 2; proposed site for the Wal-Mart retail store) in March 1993 to investigate the presence of gasoline contamination. A gasoline plume delineated on the Seaman property was believed to have originated on the Larsen property. Four monitoring wells were installed as part of this site assessment: PW-1, PW-2C, PW-2D, and PW-3. One soil sample was collected from each well during drilling (four samples total), and one groundwater sample was obtained from each of the new wells (four water samples total) once they had been completed (Spratt and Associates 1993). All samples were analyzed for GRO and BTEX. Oversight of the work was provided by Envirocon, Inc. who was contracted to represent the property owner, Peter Larsen (the Larsen property was leased by Northern Energy during this time). Site investigation activities were also summarized in the Envirocon, Inc. report, *Larsen Property Groundwater Investigation*, dated May 7, 1993. No chain-of-custody or laboratory report information is available regarding whether or not trip blanks were collected or analyzed for this event.

AES, Report Dated: April 15, 1994 – Yale Oil

In November 1992 AES, on behalf of the Exxon Company, initiated abatement activities at the Yale Oil facility based on a Remediation Action Work Plan approved by DEQ in September 1992. The primary goals of the remediation activities were to demolish and remove the existing tank bottom, underground piping, buildings, and miscellaneous foundations. In addition, contaminated soils were to be excavated, treated, and backfilled. Before any field activities began, protective poles were installed around monitoring wells MW-3, MW-4, and MW-10, and monitoring wells MW-1, MW-2, MW-5, MW-15, MW-16, and MW-17 were abandoned. Field activities began in November 1992 and ceased in September 1993. The gasoline station, the warehouse, and the shed north of the warehouse all were demolished. The tank bottom, measuring 40 feet in diameter with walls 1 foot high, contained rainwater, oil, and sludge. Twelve hundred gallons of rain water were first removed from the tank bottom, followed by 1,800 gallons of oil, and then by the solid material at the bottom (AES 1994). The oil was pumped out of the tank bottom by Olympus Environmental, Inc. and transported by Northwest Environmental Services to their facility for recycling. The rainwater was pumped from the tank bottom into a skid tank (location not specified). The remaining oily solid material at the bottom was solidified, removed from the tank bottom with an excavator, and transported to the Chemical Waste Management landfill in the fall of 1993. The tank bottom was then demolished and removed from the premises. Soil in the area of the tank bottom was excavated, treated by thermal desorption, and backfilled. All piping associated with the former Exxon Bulk Plant, was removed by digging trenches. This piping was associated with the bulk tank foundations, the former tank bottom, the gasoline station, the warehouse building, and the loading racks. Product from the pipes was moved into storage containers before it was transported off the site. Three separate areas were overexcavated; soil samples were collected from various locations during the excavation. The samples were analyzed for TPH, PAH, and BTEX. The area of the former tank bottom was excavated to approximately 25 feet deep. An area near the bulk tank foundations was overexcavated to a depth of 25 feet. A third area around a concrete pad near monitoring well MW-13 was excavated to approximately 2 feet bgs. Soil excavated from these areas and the trenches was stockpiled at the site and processed through a rock crusher assembly. The soil was then treated by an on-site thermal desorption unit. Approximately 10,465 tons were treated and used in backfilling the excavations. Roughly 200 cubic yards (yd^3) of soil was not used as backfill material because concentrations of TPH exceeded the 1,300 parts per million limit set by the State of Montana. The remaining 200 yd^3 that could not be used were spread on a plastic liner in an 18-inch thick layer and covered with plastic and were eventually removed in April 1997 to an unknown Exxon approved disposal facility (DEQ 2005b). A total of 52 soil samples were collected from the site during the field work including post-excavation confirmation samples collected from the tank bottom excavation, the excavation perimeter, and from the pipe removal trenches. An additional four split-spoon samples were collected from the soil borings. Four boreholes were drilled on the property to a depth between 22 and 31 feet bgs. Hydrocarbon-contaminated sand was reported at a depth of 19 to 23 feet for the first borehole. A diesel odor was recorded from 19 to 20 feet in the second borehole and from 18 to 20 feet bgs for the fourth borehole. No evidence of hydrocarbons was detected at the third borehole. Soil samples were also collected of the treated soil. Samples were collected twice a day at an average rate of one composite soil sample per every 70 tons of treated soil and tested for TPH. A total of 168 samples were collected from the treated soil (AES 1994).

2.3.7 Investigations Conducted in Calendar Year 1994

Tetra Tech, Inc., Report Dated: March 1, 1995 – Wal-Mart

In 1994, Tetra Tech, Inc. (separate company from Tetra Tech EM Inc. that is preparing the DSR) conducted a remedial investigation at the Wal-Mart site (referred to in the report as Jefferson Center). The work involved conducting a soil permeability test to evaluate whether the existing network of wells would support a soil vapor extraction (SVE)/air sparging system, installing new monitoring wells, soil sampling, removing and disposing of soil, installing the SVE/air sparging, operating and maintaining the system, and site monitoring (Tetra Tech Inc. 1995a). On April 22, 1994 five boreholes were drilled and sampled (EH-2, 2A, 2B, 2C, and 2D) in an effort to characterize the extent of surface and subsurface soil contamination surrounding monitoring well EH-2. The samples were analyzed for DRO and total metals. Once the extent of contamination was delineated, the soil was excavated and removed from the site. Eight confirmation soil samples were collected from the walls and bottom of the excavated area and analyzed for DRO. The results of the soil permeability test demonstrated that an SVE and air sparging system could be used to treat groundwater contamination at the site. As a result, four new wells (NW-1 through NW-4) were constructed and existing wells PW-1, PW-2D, PW-2C, PW-3, SW-8, and SW-9 were redrilled to install the SVE/air sparging system. The SVE/air sparging remediation system was designed and installed and became operational on December 2, 1994. The vapor emissions were monitored every day for the first week and once a week for the first month. Groundwater samples were collected from the wells (that were part of the SVE/sparging system) in October 1994, on a quarterly basis in 1995, and again in July 1996 and were analyzed for GRO and BTEX (Tetra Tech Inc. 1995a and TTEMI 2005a).

MSE, Inc., Report Dated: 1994 – KPT / Reliance

MSE, on behalf of DEQ, prepared a draft HRS package for the KPT and Reliance facilities in 1994. An evaluation of the facilities indicated that both KPT and Reliance (in combination) were candidates for the NPL. The facilities were never actually proposed for listing, but the HRS package was prepared.

2.3.8 Investigations Conducted in Calendar Year 1995

Secor International, Reports Dated: May 22, September 25, and November 27, 1995 – Yale Oil

Secor International conducted a quarterly groundwater investigation for the Exxon Company at the Yale Oil facility in 1995. The Yale Oil monitoring wells, GWY-3, GWY-4 and GWY-7 through GWY-13, were sampled for three quarters, in April, August, and October 1995. Groundwater samples were analyzed for SVOC and BTEX in April, for SVOC, BTEX, DRO, and GRO in August, and for BTEX, DRO, GRO, and chlorinated herbicides in the October sampling round. Results for each of these sampling events are discussed in the report, "Final Quarterly Status Report, Former Exxon Kalispell Bulk Plant, Kalispell, MT," dated May 22, 1995, September 25, 1995, and November 27, 1995 (Secor International, Inc. 1995).

Tetra Tech, Inc., 1995 Phase II ESA – Wal-Mart

Tetra Tech, Inc., drilled four borings on the northwestern corner of the Wal-Mart property in Kalispell, Montana, as part of a Phase II ESA conducted in 1995 (Tetra Tech Inc. 1995b). Borings 1 through 4 were drilled on June 5, 1995 and five soil samples were collected: two samples from Boring 1 and one each from Borings 2, 3, and 4. The soil samples were analyzed for GRO, DRO, and purgeable organics. Once the borings were drilled, temporary monitoring wells were installed in each boring. The well for Boring 1 was installed to a depth of 24 ft bgs and the well for Boring 4 was installed at a depth of 21 ft bgs. The wells for Borings 2 and 3 were constructed to a depth of 23 ft bgs. Temporary wells were installed in each of the borings, and groundwater samples were collected from each well and analyzed for GRO, DRO, and purgeable organics. A permanent well was established at Boring 1, but wells 2, 3, and 4 were abandoned after they were sampled (TTEMI 2005a).

Remediation Technologies, Inc. (RETEC), Report Dated: July 1995 – KPT

BNSF contracted RETEC to conduct a 6-month site investigation of the KPT facility, from November 1994 to April 1995, to validate previous site investigation results, define the extent of groundwater contamination, and complete a hydrogeologic evaluation of the site (RETEC 1995). Eight monitoring wells (KPT-1 through KPT-8), including one deep well on the east side of the KPT property (KPT-8), were installed, and groundwater samples were collected from each. Groundwater samples collected in November 1994 were analyzed for VOC, SVOC, and PCP. Groundwater samples collected in March 1995 were analyzed for PCP. Monitoring well GW-4 (installed during the in 1990 investigation by MSE, Inc.) was abandoned in accordance with Montana state requirements during the RETEC operations. (Figures in this report depict monitoring wells GW-2 and GW-3 also being abandoned, but it is not mentioned in the text.) Seven test pits were excavated near many of the same test pit locations as in the Weston 1992 investigation. Subsurface samples were collected from depths of 2 to 20 feet bgs and analyzed for PCP, SVOC, and dioxins and furans. Results confirmed the extent of PCP concentrations previously reported by Weston (1992). In addition, groundwater levels and product presence and thickness were monitored every month from November 1994 to April 1995. Data were collected from wells at the KPT and Reliance facility wells GWRR-1 through GWRR-3 (RETEC 1995).

2.3.9 Investigations Conducted in Calendar Year 1996

Pioneer Technical Services (PTS), Report Dated: December 1997 – Reliance

PTS prepared an FS report for the Reliance facility in 1996 to evaluate potential alternatives for the remediation of petroleum contaminated surface and subsurface soils and sludge. The document presented background information pertaining to the facility, state and federal Environmental Requirements, Criteria, and Limitations (ERCL), a summary of risk assessment process, the remedial objectives for the interim action, and several remedial alternatives. Alternatives regarding groundwater remediation were not discussed in the document for the following cited reasons: 1) limited funding for the remediation of the facility at the time and 2) the presence of an off-site, upgradient contamination source that also contributed to groundwater contamination (PTS 1997).

PTS, Report Dated: December 2000 – Reliance

PTS conducted an RI at the Reliance facility for DEQ in March and April 1996. The objectives of this investigation were to better characterize the extent of contamination, to identify the waste sources, to gather sufficient data to conduct a risk assessment, and to assess migration pathways of the contamination for the state-owned property. Four monitoring wells (GWRR-4 through GWRR-7) were installed. Well GWRR-4 was constructed north of the railroad tracks in the northern portion of the Reliance property, well GWRR-5 was installed in the center of the southern portion, well GWRR-6 was installed along the Montana Power Company (currently Northwestern Energy) pipeline in the southern portion, and well GWRR-7 was constructed just east of the abandoned railroad car in the southern portion of the Reliance property. Nine groundwater samples were collected: seven at the Reliance property (GWRR-1 through GWRR-7), one from well MW-12 at the Yale Oil facility, and one from monitoring well GW-5 at the KPT property. Groundwater samples were analyzed for PCP, picloram, VOC, DRO, and/or SVOC. In addition, 99 test pits were dug on the Reliance premises. Sixteen were dug to the west of the Reliance facility on the KPT facility, eight were dug in the northern portion, and 75 were dug in the southern portion. Soil samples from individual test pits were composited for some of the analyses. One hundred and fifteen soil samples were sent to a laboratory for analysis of one or more of the following analytes: PCP, lead, DRO, SVOC, EPH, and VPH. Included in the 115 samples was one background soil sample that was collected off site in a location with similar geologic material (PTS 2000). A site survey was conducted during the RI and the groundwater elevations (19 wells), soil sampling locations (99 test pits), and the Montana Power Company gas line were surveyed by DNRC personnel. The survey data were not developed using an established benchmark, but by development of GPS survey data collected at the KPT facility by a surveying company in 1994.

Montana Department of Environmental Quality (DEQ), May 1996 – Rask Residential Well Sampling

In May 1996, DEQ sampled the Rask residential well located northeast of KPT and north of Reliance on Flathead Drive. The resident reported that the water "had a diesel odor and a dark gray film was present in the reserve salt bin of the water softener". A groundwater sample was collected and analyzed for PCP and TPH. The Rask residence was connected to the local public water supply, and the pump and piping associated with the well were removed (DEQ Correspondence 1996).

Remediation Technologies, Inc (RETEC), Report Dated: March 16, 1998 – KPT

In August 1996, RETEC, contracted by BNSF, collected samples as part of a supplemental field investigation at the KPT facility. The objectives of this investigation were to delineate PCP on adjacent properties, characterize the western boundary of the LNAPL plume, define the extent of surface soil concentrations of PCP, and investigate the rate and direction of groundwater flow in the area (RETEC 1998). Seventeen test pits were excavated during this investigation: 12 test pits (TP-106 through TP-117) were excavated in the northeastern, northern, and southwestern areas of the KPT facility, and five (TP-100 through TP-104) were located in the central and southern portions of the property to delineate the extent of the LNAPL plume. Fifteen soil samples were collected from the test pits and analyzed for PCP and chlorophenols. Seven additional monitoring wells were installed; two shallow wells (KPT-9 at 16.5 feet bgs and KPT-10 at 23.5 feet bgs) were constructed in the northeastern portion of the KPT facility. A third well (KPT-12, 24.5 feet bgs) was installed south of the former treatment area. Three deep monitoring wells (KPT-13 through KPT-15, 106 to 119 feet bgs) were installed in the northeast and eastern portion of the KPT property. The remaining well, KPT-11, was installed in the northern portion of the Reliance facility at a depth of 75 feet bgs. Groundwater samples were collected between September 1996 and August 1997 on all accessible wells on the KRY site where LNAPL was not present and analyzed for PCP, chlorophenols, DRO, or VOC. (Several sampling events were involved; most wells were sampled in September and December 1996 and January, February, March, and August 1997.) Exceptions to this LNAPL guideline were wells KPT-4, GWRR-2, and GWRR-5. The Rask residential well was included in these sampling events (RETEC 1998).

RETEC, Report Dated: May 1996 – KPT

As an interim action to reduce off-site contamination, RETEC installed a pilot-scale air sparging system along the downgradient boundary of the BNSF property in 1996 (RETEC 1996) on behalf of BNSF. The system consisted of 11 injection wells arranged in a single line with 25-foot spacing between each well. The wells were all drilled to 35 feet bgs. When the system was activated in September 1996, RETEC began assessing its ability to reduce concentrations of PCP through monthly monitoring at shallow monitoring wells KPT-7 and KPT-9 and at air sparging monitoring wells OSW-1 and OSW-2. Well OSW-1 was constructed 20 feet west of and upgradient from the air injection wells, and well OSW-2 was installed 20 feet east of and downgradient from OSW-1. Performance monitoring consisted of collecting groundwater samples from wells KPT-7, KPT-9, OSW-1 and OSW-2 and measuring groundwater elevation, the presence and thickness of lighter-than-water nonaqueous phase liquid, as well as groundwater pH, dissolved oxygen, and oxidation reduction potential (RETEC 1998).

2.3.10 Investigations Conducted in Calendar Year 1998

DEQ, Report Dated: May 1998 – Reliance

Personnel from DEQ collected 50 shallow soil samples in May of 1998. Twenty of these samples were analyzed for diesel-range organics, 29 were analyzed for lead, and one was analyzed for BTEX. The soil samples were collected from the northern and southern areas of the Reliance property (as divided by the BNSF railroad spur line) and were centralized in the south-central area of each portion (Land and Water Consulting, Inc. [LWC] 2002b).

2.3.11 Investigations Conducted in Calendar Year 1999

ThermoRetec Consulting Corporation (ThermoRetec, now The Retec Group, Inc.),
1999 (unpublished) – KPT

In the summer of 1999, a pilot-scale ozonation system was installed at the KPT facility on behalf of BNSF. This system was composed of 11 ozone injection wells (OIW-1 through OIW-10) arranged in a single line on 25-foot centers 25 feet downgradient of the air sparging system that was constructed on the site in 1996. Ozonation monitoring wells OMW-1 through OMW-4 were installed on April 7, 1999 (see ThermoRetec 2001, Table 28). It is possible monitoring wells OMW-5 and OMW-6 were installed during this interim action, either as injection wells or monitoring wells, but documentation on their installation cannot be located.) Groundwater monitoring of the system was conducted on a semi-annual basis as part of the larger groundwater monitoring effort (see Investigations Conducted in Calendar Years 1999-2004)(Environmental Resources Management [ERM] West, Inc. 2005).

ThermoRetec, Report Dated: January 15, 1999 – KPT

As identified in the *Pentachlorophenol Hot Spot Removal Work Plan*, soil samples were collected from the KPT facility during June, July, and August 1998 in areas where historical hot spots for PCP had previously been identified. A total of 69 surface soil samples were collected from 42 locations and analyzed for PCP to further delineate the hot spots. RETEC then used the results of this sampling effort to remove contaminated soil from the KPT property in April 1999 (see below)(ThermoRetec 1999).

ThermoRetec, Report Dated: July 28, 2000 – KPT

As discussed in the *Excavation Completion Report*, soil contaminated with PCP was excavated from the KPT facility in April 1999 and disposed of at the Waste Management Industrial Services Subtitle C landfill in Arlington, Oregon. Soil was excavated to a depth of 6 feet bgs, and approximately 470 yd^3 of surface and subsurface soil was removed and disposed of. Before the excavated area was backfilled, three soil samples were collected from the base of the pit (6 feet bgs) and analyzed for PCP. Two of the samples collected from the base of the excavated area were also analyzed for dioxins and furans. A composite sample from the excavated soil was also collected before it was disposed of and was analyzed for dioxins and furans only (ThermoRetec 2000).

2.3.12 Investigations Conducted in Calendar Year 2000

Maxim Technologies, Inc., November 29, 2000 – Yale Oil

Maxim Technologies conducted groundwater sampling at the Yale Oil facility in 2000. Samples were collected from monitoring wells GWY-3, GWY-4, GWY-10, GWY-12, GWY-13, and GWY-14 and analyzed for VPH (DEQ 2005b).

2.3.13 Investigations Conducted in Calendar Year 2002

Land and Water Consulting (LWC), Report Dated: July 2002 – Reliance

LWC was contracted by McElroy and Wilken to collect soil and groundwater samples on the Reliance property in April 2002. Two monitoring wells (GWRR-8 and GWRR-9) were installed, and soil samples were collected from three test pits and two surface soil locations. Soil samples were analyzed for EPH, VPH, PAH, PCP, lead, and/or dioxins and furans. Groundwater samples were analyzed for the same with the exception of lead. Monitoring well GWRR-8 was installed on the northeast side of the McElroy and Wilken property, south of Flathead Drive and the Reliance facility. Monitoring well GWRR-9 was installed southwest of well GWRR-2 on the Reliance property (LWC 2002a).

LWC, Report Dated: December 2002 – Reliance

In June and October 2002, LWC collected additional soil samples at the Reliance facility as part of a Phase II RI/FS for DNRC. The purpose of the RI/FS was to provide rationale for the selection of a remedial action alternative that would address contamination in soil and groundwater at the site (LWC 2002b). Soil samples were collected from 16 locations in the northern portion of the property. Three samples were collected from each location at depths of 0 to 2 feet bgs, 4 to 6 feet bgs, and 8 to 10 feet bgs, for a total of 48 samples; these soil samples were analyzed for VPH and EPH. Three surface soil samples were collected from separate locations in the southern area for analysis of dioxins and furans. In addition, six soil samples were obtained from the property for QA/QC. Groundwater samples were collected on July 10 and October 1, 2002. Samples were collected from monitoring wells GWRR-1, GWRR-3, and GWRR-6 and analyzed for VPH, EPH, PCP, and dioxins and furans. Groundwater levels were also measured for each well on the Reliance property in both July and October (LWC 2002b). During this investigation two, twelve-inch diameter, free product recovery wells were installed in July 2001 in areas with elevated subsurface soil contamination (as identified in the Pioneer Phase I RI). Recovery Well #1 (RW-1) was installed west of monitoring well GWRR-3 and Recovery Well #2 (RW-2) was installed 20 feet west of monitoring well GWRR-7. The wells were both equipped with belt oil skimmers. RW-1 averaged approximately 1.25 gallons of product per day (this quantity is assumed to be based on a period of operation from July 2001 through December 2002 when LWC published the Phase II RI/FS). RW-2 did not recover appreciable amounts of free product, so the belt skimmer was moved from RW-2 to GWRR-7 in September 2002 and retrofitted to accommodate a smaller well diameter.

Hydrometrics, Inc., May 8, 2002 – Yale Oil

Hydrometrics, Inc. conducted groundwater sampling at the Yale Oil facility in 2002. Samples were collected from monitoring wells GWY-3, GWY-4, GWY-10, GWY-12, GWY-13, and GWY-14 and analyzed for VPH (DEQ 2005b).

2.3.14 Investigations Conducted in Calendar Years 1999—2004

ThermoRetec, Reports Dated: 1999 – 2004 – KPT / Reliance / Yale Oil

ThermoRetec (now known as The RETEC Group, Inc.) has conducted semi-annual groundwater monitoring on the BNSF property since 1999. Groundwater sampling occurred once in February 1999, once in July 2001, and then semi-annually since August 2002. Water levels were measured at wells GW-1, GW-5, KPT-1 through KPT-16, OSW-1, OSW-2, OMW-1 through OMW-4, GWRR-2 through GWRR-5, GWRR-7 through GWRR-9, GWY-4, GWY-10, GWY-12, GWY-14, PW-1, and SW-9. Groundwater samples were collected at wells GW-1, GW-5, KPT-4, KPT-5, KPT-6, KPT-7, KPT-9, KPT-10, KPT-12, KPT-16, OSW-1, OSW-2, OMW-1, OMW-2, OMW-3, OMW-4 (KPT facility), GWRR-2, GWRR-4, GWRR-5, GWRR-7 (Reliance facility), GWY-4, GWY-10, GWY-12, and GWY-14 (Yale Oil facility) for analysis of PCP. Depending on the monitoring event, some of the groundwater samples were also analyzed for EPH, SVOC, PAH, or dioxins and furans. When each monitoring event was complete, reports were submitted to DEQ detailing the sampling, water level measurements, potentiometric data, and analytical results. The most recent groundwater monitoring event occurred in April 2005.

2.3.15 Investigations Conducted in Calendar Year 2004

Environmental Management Services (ERM) West, Inc. 2005 – KPT

ERM installed and activated a full-scale In Situ Ozonation System (ISOS) between May and September 2004 for BNSF in order to accelerate the remediation of the facility by enhancing the in situ groundwater remediation system and LNAPL recovery system (northern area of the facility), expand the remediation system to the PCP and hydrocarbon plume in the southern area of the facility, and to incorporate the existing pilot-scale air-sparging system. Seven of the existing wells from the pilot-scale air sparging system installed in 1996 (ASW-1 through ASW-5, ASW-8 and ASW-10) were converted to ozone injection points NBO-1 through NBO-5, NBO-7, and NBO-9. Three of the existing wells from the pilot-scale ozonation system installed in 1999 (OIW-6, OIW-8, and OIW-10) were converted to full-scale ISOS wells NBO-6, NBO-8, and NBO-10 to allow a higher volume of ozone to be injected. In addition, 10 ozone injection wells (SBO-1 through SBO-10) were installed along the east and southeast boundaries of the KPT facility. A second set of 10 ozone injection points (SAO-1 through SAO-10) were installed along the southern portion of the BNSF property (upgradient of the other two injection lines). Two new monitoring wells, SBM-1 and SBM-2, were constructed near the SBO line of injection wells. The ISOS system is intended to accelerate remediation of the BNSF property and facilitate improved tracking of the remediation effort (ERM 2005).

2.3.16 Investigations Conducted in Calendar Year 2005

Corwin Environmental Consultants, Inc., Report Dated: April 26, 2005 – Rocky Mountain Marine

Corwin Environmental Consulting conducted a Phase II ESA on behalf of Rocky Mountain Marine (south of the Yale Oil facility) in April 2005. Four borings were excavated and eight composite soil samples were collected (2 from each boring) and sent for EPH screen analysis. Two groundwater monitoring wells were installed in two of the borings to a depth of 25 ft bgs. MW-01 was constructed in the east portion of the Rocky Mountain Marine property and MW-02 was constructed in the west portion. Groundwater samples were collected from each well and also analyzed for EPH screen (Corwin 2005).

2.3.17 Other Investigations

This section presents summaries of other investigations near the KRY site. Few, if any of the data from these investigations were included in the DSR.

Stillwater River Surface Water Sampling

Five surface water monitoring stations are located on the Stillwater River near the KRY site and are shown on Figure 2-7 (NRIS 2005a). Existing data on surface water quality for two surface water monitoring stations located on the Stillwater River upstream of the confluence with the Whitefish River are in the storage and retrieval (STORET) database and are accessible by MDEQ. These stations include: (1) station 5614ST03, 2,500 feet upstream from the KRY site, and (2) station 5614ST01, 350 feet upstream of the KRY site. Samples were collected in July and October 1978, March 1979, and March

1983. Parameters that were measured included flow, common ions, nutrients, temperature, and pH. No inorganic or organic analytes were included in these data. No data from these stations have been included in the DSR at this time.

One additional surface water monitoring station (TMP0037) is located 2,000 feet downstream of the KRY site, just upstream of the confluence with the Whitefish River. Parameters that were measured include flow, common ions, nutrients, and inorganic and organic constituents. Data collected at this station are managed by the Flathead Lake Biological Station and have been obtained for 1995 through 1996; however, results do not include any chemicals of interest.

Two surface water monitoring stations are located on the Stillwater River downstream of the confluence with the Whitefish River; they include station BSC04005, immediately downstream of the confluence, and station 5614ST02, 3,500 feet downstream of the confluence. Data from station BSC04005 are likewise managed by the Flathead Lake Biological Station and have been obtained. Data from station 5614ST02 have been obtained through the MDEQ STORET database. Surface water quality data at station 5614ST02 were collected in July and November 1973, May through September 1976, and April 1984. Parameters that were measured included flow, common ions, nutrients, temperature, and pH.

Underground Storage Tank Investigations

Six active or inactive underground storage tanks, petroleum release sites, or petroleum tank release compensation board sites are located near the KRY site based on MDEQ Remediation Division information obtained from Montana NRIS (NRIS 2005b) and based on a review of DEQ files. The locations of these sites are shown on Figure 2-8 and are based on reported street addresses. Actual tank locations at these addresses have not been identified. Available analytical data for these sites has been obtained from DEQ. Each of these investigation sites is discussed below.

Investigations at the Seaman Larson Property are discussed in Section 2.3.5. Geotechnical, groundwater, soil, and soil vapor extraction system data were obtained during these investigations.

One 500-gallon gasoline underground storage tank owned by Stillwater Forest Inc. at 955 Whitefish Stage was installed in 1976, used until 1986 and removed in 1996. No evidence of a leak was detected (NRIS 2005b).

One 300-gallon gasoline underground storage tank owned by Klingler Lumber at 250 Flathead Drive was installed in 1979 and removed in 1990. No evidence of a leak was detected (NRIS 2005b).

A release has been confirmed from a non-underground storage tank at LeDuc Motors on Highway 2 East dated June 3, 1995. This site is still active, according to MDEQ records.

The McElroy and Wilken Inc. at 801 Whitefish Stage Road #2 is an active facility with three underground storage tanks currently in use and three underground storage tanks that have been removed. A 3,000-gallon used oil tank that was installed in 1979 was removed in 1994. No evidence of a leak was detected (NRIS 2005b). A 12,000-gallon diesel tank was installed in 1978 and was removed in 1994. Evidence of a leak from this tank was detected. A 6,000-gallon gasoline tank installed in 1978 was also removed in 1994. Evidence of a leak was also detected for this tank. According to MDEQ records, site assessment and cleanup have been resolved as of March 2005.

Town Pump, Inc., is an active fueling station located at 1100 East Idaho (Highway 2 East). The five gasoline and diesel underground storage tanks at this gas station were installed in 1997. No leaks have been reported at this site (NRIS 2005b).

3.0 PHYSICAL CHARACTERISTICS AND ENVIRONMENTAL SETTING

This section provides a summary of the geography, climate, ecology, geology and soils, groundwater hydrology, and surface water hydrology at the site.

3.1 GEOGRAPHY

Kalispell lies in the Upper Flathead Valley, an intermountain valley drained by the Flathead River and its tributaries, the Whitefish, Stillwater, and Swan Rivers. The Flathead River flows in a general southerly direction on the eastern edge of Kalispell and empties into Flathead Lake 7 miles (11 kilometers) south of Kalispell. Flathead Lake is the largest freshwater lake west of the Mississippi River. The KRY site is located south of and adjacent to the Stillwater River on bottom lands and low terraces one-half mile above the confluence of the Stillwater and Whitefish Rivers. The site lies 2 miles above the confluence of the Stillwater and Flathead Rivers.

Sources of domestic water in the vicinity of the KRY site are from the Evergreen Water District (EWD) Public Water Supply and private wells. In addition, other domestic (such as irrigation), commercial, and nondomestic use water is known to come from the shallow aquifer via several individual wells. Sewerage in the vicinity is provided by individual septic systems and public sanitary systems as shown on Figure 2-2. Locations without individual septic systems are assumed to be connected to the public sanitary systems.

Kalispell is the county seat of Flathead County and is the largest city and commercial center of northwest Montana. As of the 2000 census, the total population of Kalispell was 14,223 and its 2004 population was estimated at 17,381 (U.S. Census Bureau 2005). Land use in the vicinity of the KRY site is shown on Figure 2-3 and includes a mix of residential, commercial, industrial, and open space. Examples of commercial and light-industrial businesses in the area include lumber processing, open-cut gravel mining, recycling, retail stores, storage, and a motel. A summary of nearby residential properties adjacent to the KRY site is provided in Table 3-1.

3.2 CLIMATE

The climate of Kalispell is typical for the Northern Rocky Mountain region. The wettest months are early in summer (May and June) with most of the winter precipitation falling in December and January, primarily as snowfall. Climate information was evaluated for two local weather stations, one located at the Kalispell regional airport (weather station 244558) and one within the Kalispell city limits (weather station 244563). Because of local influences, wind conditions at the airport are not considered to represent of the entire valley (U.S. Department of Agriculture [USDA] 1960). The prevailing wind direction for the year is from the west in Kalispell; however, it is from the south at the airport, about 8 miles north-northeast from Kalispell. Therefore, only climate information for weather station 244563 was evaluated for this report.

Climate information was obtained from the Western Regional Climate Center (WRCC 2005) for weather station number 244563 and is included in Appendix A. Kalispell's climate is considered semiarid, with an average 15.15 inches of precipitation per year and an average temperature of 44.4 °F. The climate records extend from the year 1948 to 2005. In the 57-year period of record, the maximum amount of precipitation in 1 year was 20.29 inches in 1959; the minimum amount of precipitation in 1 year was 8.79 inches in 1952. The average monthly maximum temperature of 81.9 °F was reported for July, and the average monthly minimum temperature of 14.4 °F was reported in January.

3.3 ECOLOGY

The scattered and intermixed areas of forest, grass, cultivated fields, and water of the Upper Flathead Valley Area provide good food and cover for all kinds of wildlife, and lakes and rivers are considered excellent habitat for shore birds, blackbirds, and herons. Canada geese nest along the Flathead River, and streams and marshes provide excellent habitat for beaver and muskrat. Trout is the principal fish species; pheasants and Hungarian partridge the main upland game birds, and the white-tailed deer is the main big game animal of the valley. Other common mammals include skunks, cottontail and snowshoe rabbits, ground squirrels, and pocket gophers (USDA 1960). Although historic USGS maps of the Kalispell region indicate the presence of a "Stillwater Wildlife Preserve," Montana Department of Fish Wildlife and Parks no longer has record of a preserve in their database (TTEMI 2005c).

The Montana Natural Heritage Program has identified four animal species of concern in the vicinity of the KRY site (2005); there were no plant species of concern. Animal species of concern include the bald eagle (*Haliaeetus leucocephalus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), bull trout (*Salvelinus confluentus*), and the lynx (*Lynx canadensis*).

3.4 SOILS

The soil types found at the KPT, Reliance, and Yale Oil facilities are dominated by material that has been deposited by the nearby Stillwater River or streams. Soil types found at each site are described below.

KPT Facility

Four main soil mapping units are found at the KPT facility and are described in more detail in the soil survey completed for the Flathead Valley (USDA 1960). The soil mapping units include the following:

- Aa: Alluvial land, poorly drained. This land type characteristically has poor surface and internal drainage. Surface soils are generally darker, the subsoil is typically mottled, and the surface soil and upper subsoil layers are more loamy and silty. The surface soil is sandy and light colored in areas adjacent to stream channels. The land type occupies nearly level areas, slight depressions, seep spots next to higher land in the broad floodplains, and poorly drained narrow valleys where stream channels are not well defined. The land is subject to flooding.

- Ba: Banks loamy fine sand, 0 to 4 percent slopes. Banks soils are sandy soils that occupy floodplains and are subject to frequent flooding. They are developed in recently deposited, very sandy alluvium.

- Bc: Birch fine sandy loam, 0 to 5 percent slopes. Birch soils are shallow, light-colored sandy soils found on high terraces and low bottoms. They are underlain by loose, gravelly sand at depths ranging from 10 to 24 inches. These soils have been developed from alluvium that washed from mountains and from older high terraces where larger streams are now entrenched. The alluvium was derived from quartzite, argillite, dolomite, and limestone. The soil is low in organic matter and well drained.

- Rc: Riverwash. Riverwash is fresh alluvium not yet developed into a soil. This mapping unit consists of areas of light-colored, alluvial sand mixed with a small amount of gravel. Some of the areas in sharp river bends are mainly gravel and a little coarse sand.

Reliance Facility

Only one soil unit has been identified for the Reliance facility:

- So: Swims silt loam, 0 to 3 percent slopes. Swims series consists of deep, light-colored silty soils. These soils have developed in deep, light-colored, medium-textured, calcareous alluvium on high bottom lands and low terraces. The parent material was derived from argillite, quartzite, and dolomitic limestone, all of the Belt Supergroup geological formation. The soils have been reworked from glacial drift.

Yale Oil Facility

One soil unit has been identified for the Yale facility property:

- Mg: Mires gravelly loam, 0 to 3 percent slopes. Mires series consists of moderately deep, medium-textured soils with a gravelly, coarse-textured lower soil and substratum. The soils have developed in calcareous outwash and terrace alluvium. The parent materials were deposited by swift waters during the retreat of the glaciers from the valley and adjacent mountain slopes. The Mires soils are well drained.

3.5 GEOLOGY OF THE KALISPELL VALLEY

The regional geology of the Kalispell Valley and local site geology are described in the following sections.

3.5.1 Regional Geology

The Kalispell Valley is a north-northwest trending intermontane basin located within the southern extension of the thousand-mile-long Rocky Mountain Trench (Harrison and others 1992). The trench was formed in the late Paleocene to Eocene. Normal faults are found along the eastern and western sides of the Kalispell Valley and numerous faults cross-cut the basin, contributing to the irregular shape of the basin (Kendy and Tresch 1996). The down-dropped crustal block (graben) that occupies the Kalispell Valley contains approximately 4,000 feet of Cenozoic basin fill deposits at its deepest point (Noble and others 1982, Harrison and others 1992).

Bedrock in the area consists of Middle Proterozoic Belt Supergroup metasediments that surround the Kalispell Valley. The metasediments include argillite, siltite, quartzite, dolomite, and limestone (Harrison and others 1992).

Tertiary sediments do not crop out in the Kalispell Valley (Konizeski and others 1968). However, like other basins in the Rocky Mountain Trench, a thick sequence of Tertiary sediments exists in the basin and is overlain by glacial and alluvial sedimentary units (Harrison and others 1992). A deep oil exploration well drilled in 1984 just north of Kalispell (near Whitefish) encountered the Belt Supergroup Helena Formation at a depth of 1,695 feet. Tertiary sediments, including lignite, clay, and argillaceous, sandy siltstone, overlie the Helena Formation from 1,695 feet to 1,120 feet bgs. Peat, clay, and some sand were found from 1,120 feet to 600 feet bgs. Pleistocene glacial deposits overlie the Tertiary sediments from 600 feet bgs to the surface (Kendy and Tresch 1996).

Based on a Cenozoic basin fill isopach map prepared for the Kalispell Valley, approximately 600 to 1,000 feet of Quaternary glacial deposits and alluvial sediments overlie the Tertiary deposits (Noble and Stanford 1986). The base of the Quaternary deposits consists of glacial outwash deposits that are well-sorted, poorly bedded sand, gravel, cobbles, and boulders. The glacial outwash deposits are interbedded with and underlie discontinuous lenses of fine-grained glacial till and glacial lakebed deposits (Kendy and Tresch 1996). The north-central and western parts of the Kalispell Valley, except for the Stillwater flats area, are underlain mostly by till that formed moraines and drumlins, and by glacial outwash that is overlain by a thin mantle of glaciolacustrine silt and sand (Konizeski and others 1968). The east and central valley terraces are underlain mostly by till and kame deposits of well-rounded, well- to poorly sorted stratified gravel and cobbles. Kame deposits more than 100 feet thick are exposed in gravel pits within the city limits of Kalispell. The till and kame deposits are overlain by a thin mantle of glaciolacustrine silt and sand (Konizeski and others 1968).

Holocene (Recent) floodplain alluvium is typically material reworked from the glacial drift and deposited in a wide range of fluvial and alluvial environments. The northern end of the Kalispell Valley is dominated by well-sorted, interbedded gravel and sand; the southern end of the valley is primarily silt and sand (Konizeski and others 1968).

3.5.2 Local Site Geology

The KPT, Reliance, and Yale Oil facilities are located adjacent to or in close proximity to the Stillwater River, just north of Kalispell, at an elevation of 2,920 feet above mean sea level. The KRY site is a relatively flat, broad floodplain that is composed of fluvial materials ranging from clay- to cobble-sized materials (ThermoRetec 2001). These deposits are characteristic of a high-energy system with occasional quiescent periods (EPA 1992a). Boreholes drilled as part of previous investigations have extended to a maximum depth of 135 feet bgs (RETEC 1995). The upper 30 feet consists of interbedded and intermixed sand and gravel with some cobbles, silty sand, and clay. Silty sand primarily underlies the upper material and extends to a depth below 100 feet. Generalized geologic cross sections of the three sites (KPT, Reliance, and Yale) are presented on Figures 3-1 and 3-2.

3.6 SURFACE WATER AND GROUNDWATER RESOURCES

Regional surface and groundwater resources of the Kalispell Valley have been previously investigated by the U.S. Geological Survey (1996) and others, and a summary of available regional information is provided below. Previously published site-specific information related to hydrology and hydrogeology for the KPT, Reliance, and Yale Oil facilities is also summarized in the following sections.

3.6.1 Summary of Regional Surface Water Resources

In general, the southwestward-flowing Flathead River is the principal surface water flow in the Kalispell Valley. Major tributaries include the Whitefish, Stillwater, and Swan Rivers. The Whitefish River flows into Whitefish Lake from the north and then southward from the lake at a gradient of about 2 feet per mile to its confluence with the Stillwater River on the northeastern outskirts of Kalispell. The Stillwater River enters the basin from the northwest and flows south-southeastward at a gradient of about 2 feet per mile to its confluence with the Flathead River about a mile southeast of Kalispell. The Flathead River enters the basin from the east near Columbia Falls, and flows south-southwestward toward Kalispell at an average gradient of about 6 feet per mile.

About one-third of the flow of the Flathead River (that is, the contribution from the South Fork of the Flathead River) has been regulated by Hungry Horse Reservoir since 1951. Below Kalispell, the Flathead River meanders across its delta to Flathead Lake at a reduced gradient of about 1 foot per mile. The Swan River enters the southeastern corner of the basin, through which it traverses for about 8 miles before emptying into Flathead Lake. Sixteen tributary streams enter the Kalispell Valley from the mountains; however, most of the streamflow either infiltrates directly into basin fill, or is diverted for irrigation (Konizeski and others 1968).

The Kalispell Valley contains more than 40 lakes. Flathead Lake, with an area of 126,000 acres, is the largest natural freshwater lake in the western United States (Kendy and Tresch 1996). Its natural storage capacity is increased by Kerr Dam, which was constructed in 1938.

Streamflow data are available for five gauging stations in the Kalispell area and are either stored in the USGS WATSTORE database or have been published in water-supply papers and annual water-data reports issued annually by the USGS. Flow statistics for these five stations are presented in Table 3-2.

3.6.2 Summary of Regional Groundwater Resources

Four principal types of aquifers have been characterized in the Kalispell basin (Konizeski and others 1968; USGS 1996). These include (1) Holocene floodplain aquifers, (2) Pleistocene perched aquifers, (3) Pleistocene confined aquifers, and (4) the Precambrian bedrock aquifer. The following hydrogeologic information is found in Konizeski and others, 1968 and Kendy 1996.

Holocene floodplain aquifers include the deltaic-sand aquifer south of Kalispell and the alluvial-gravel aquifer that underlies the floodplains of the Flathead and Whitefish Rivers north of Kalispell. Hydraulic characteristics of both types of aquifers are listed in Table 3-3.

The Holocene deltaic-sand aquifer south of Kalispell is not an important source of water because it is much less permeable and contains more dissolved constituents than the underlying confined aquifer. Stage fluctuations of 10 feet in Flathead Lake caused by releases from Kerr Dam annually reverse the hydraulic gradient in the deltaic-sand aquifer within one-half mile of affected surface-water bodies, including Flathead Lake, the Flathead River, and associated sloughs and oxbows. Lake water recharges the aquifer during May and June, when the lake level is highest; groundwater reverses its direction of flow and begins to discharge to the lake during mid-November, when the lake level declines below the water table. Precipitation and evapotranspiration also directly affect storage in the deltaic-sand aquifer (Noble and Stanford 1986).

The Holocene alluvial-gravel aquifer north of Kalispell is an important source of water and once provided much of the municipal supply for Kalispell. However, the susceptibility of this aquifer to contamination has prompted a shift to reliance on the underlying, confined aquifers. Most of the recharge to the alluvial-gravel aquifer occurs in April, May, and June as snowmelt and spring showers. Significant interaction between groundwater and surface water occurs along the eastern side of the alluvial-gravel aquifer in response to stage fluctuations in the Flathead River after releases from Hungry Horse Reservoir. Groundwater flow approximately parallels the direction of streamflow in most of the aquifer. Groundwater discharges from the alluvial-gravel aquifer to surface water near the confluence of the Flathead and Stillwater Rivers (Konizeski and others 1968; Noble and Stanford 1986).

Three types of Pleistocene perched aquifers are present in the Kalispell basin and are separated from the underlying confined aquifers by clay, till, or cemented gravel. These aquifers are (1) the laterally discontinuous, low-permeability, dune and lacustrine sand aquifers on the tops of terraces; (2) a gravelly, glacial-outwash aquifer northwest of Kalispell; and (3) a glacial-drift aquifer in the pothole lake area in the eastern part of the basin. Of these three types, the glacial-outwash aquifer northwest of Kalispell is the most important source of water. Its hydraulic characteristics are summarized in Table 3-3. The glacial-outwash aquifer is recharged primarily by seepage from streams, and it discharges largely to irrigation wells. The sand aquifers are not used much in comparison to the underlying Pleistocene artesian aquifer. In addition, the glacial-drift aquifer is not used much despite its favorable hydraulic properties because it is located in an area with plentiful surface water (Konizeski and others 1968).

Two Pleistocene confined aquifers are separated by 10 to 400 feet of till or 20 to 600 feet of lacustrine silt. Both confined aquifers are composed of sand and gravel. The shallower of the two is present locally near Creston, Montana, and is not laterally extensive. It is about 60 feet thick and has a specific capacity of 0.3 to 0.5 gallons per minute (gal/min) per foot.

The deeper Pleistocene confined aquifer consists of glacial outwash and underlies the entire Kalispell basin. As the principal aquifer in the Kalispell Valley, the deeper Pleistocene confined aquifer supplies municipal water for the City of Kalispell, irrigation water for hundreds of acres, and domestic water for many residents of the basin. Its hydraulic characteristics are summarized in Table 3-3. Within the deeper Pleistocene confined aquifer, groundwater generally flows from the edges of the basin toward the

Flathead and Whitefish Rivers. The aquifer is recharged by precipitation and runoff near the margins of the basin and by subsurface flow from the surrounding mountains (Konizeski and others 1968).

The Precambrian bedrock aquifer is an important source of water near outcrops and other areas where overlying basin fill is either thin or not productive. The bedrock aquifer is confined where it underlies glacial deposits of low permeability; elsewhere, it is unconfined. Wells completed in bedrock yield about 0.5 to 30 gal/min (Konizeski and others 1968). Selected hydraulic characteristics of the bedrock aquifer are also summarized in Table 3-3.

3.6.3 Summary of Local Surface Water Hydrology

The KPT, Reliance, and the Yale Oil facilities are all located in close proximity to and south, west, or east of the Stillwater River (Figure 2-1). The river generally flows from west to east, and there are currently no nearby operational stream gauging stations (USGS 1996). The KRY sites are situated outside of the 100- and 500-year floodplains (Flathead County 2005a). Floodplain designations are currently based on Federal Emergency Management Agency designations; DNRC has not conducted additional floodplain studies in the area of the KRY site (TTEMI 2005d). Surface water and groundwater in the unconfined aquifer are generally interconnected (MSE 1989), with the Stillwater River likely discharging to the upper aquifer in the vicinity of the three sites (EPA 1992a; ThermoRetec 2001). Limited surface water quality sampling for the Stillwater River just above the confluence with the Whitefish River was conducted by the Flathead Lake Biological Station (University of Montana) in 1995 and 1996.

Montana rivers and streams are classified according to the present and future beneficial uses they normally would be capable of supporting (§75-5-301 Montana Code Annotated). DEQ classifies the Stillwater River mainstem from Logan Creek to the Flathead River as "B-2" (Administrative Rules of Montana §17.30.608). DEQ classifies the Whitefish River from the outlet of Whitefish Lake to the Stillwater River as B-2. DEQ classifies the Flathead River above Flathead Lake as B-1. These classifications indicate that waters should be suitable for drinking, culinary and food processing after conventional treatment; bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

Sufficient surface water quality data exist for the Stillwater River for DEQ to compare in-stream water quality with existing water quality criteria and guidelines to make a beneficial use support determination. Based on this comparison, the Stillwater River does not fully support all uses designated under existing standards, and in 2002 the river was on the Clean Water Act §303(d) Impaired Waters List (Montana Natural Resource Information System [NRIS] 2005). Specifically, the beneficial use determination found that the river fully supports agriculture, industry, and recreation; however, it only partially supports a cold water fishery and aquatic life, and does not support a drinking water supply.

The NRIS database indicates the observed impairment of beneficial uses is caused by elevated concentrations of nitrate and phosphorus, an overall increase in available nutrients, channel siltation, and other habitat alterations. In addition, NRIS suggests that the probable sources of impairment to the river are land development, associated construction, urban runoff, and contributions from storm sewers.

3.6.4 Summary of Local Groundwater Hydrology

Subsurface geology in the project area consists of fluvial materials ranging in size from clay to cobbles (ThermoRetec 2001). Wells drilled as part of previous investigations have extended to a maximum depth of 135 feet bgs. In general, the upper 30 feet consists of interbedded and intermixed sand and gravel, with cobbles, silty sand, and clay also reported (RETEC 1995; ThermoRetec 2001). The underlying material is primarily a silty sand that extends to depths that exceed 100 feet bgs. Locally, a silty clay unit, at least 15 feet thick, and up to 51 feet thick, is present at approximately 120 feet bgs (PTS 2000; ThermoRetec 2001).

Two aquifers have been identified in previous investigations: an upper unconfined aquifer, and a deeper confined aquifer. The silty clay unit, located at approximately 120 feet bgs, is a low permeability unit between the upper unconfined aquifer and the deeper confined aquifer. In addition, perched groundwater may exist at the former Reliance facility (ThermoRetec 2001; PTS 2000). Investigations and wells completed to date at the sites have focused on the upper unconfined aquifer.

Depth to water in the upper unconfined aquifer ranges from 10 to 25 feet bgs, depending on surface topography. The calculated horizontal hydraulic conductivities (K) from slug testing have been reported to be about 35 to 48 feet per day (RETEC 1995; PTS 2000; ThermoRetec 2001). Horizontal flow gradients are between 0.004 to 0.005 feet/foot, with an overall direction of groundwater flow to the east or southeast (RETEC 1996; PTS 2000; ThermoRetec 2001). Groundwater elevations have been shown to vary seasonally up to 1.4 feet at the Reliance facility, the higher water tables coincide with spring recharge (PTS 2000). As part of the RI, well construction information and groundwater elevation data from monitoring wells across all three facilities will be compiled in one excel database to more comprehensively evaluate water level trends over time.

Localized flow directions within each facility area, however, may be more complex and variable. For example, groundwater from the Reliance facility has been previously documented to flow both west and south, and groundwater flow from the Yale Oil facility has been documented to flow west and north (MSE 1990). Local groundwater flow patterns have also likely been affected by operation of a nearby gravel pit just south of the KPT facility and by localized subsurface geology such as buried channels (Weston 1992). For instance, a buried meander channel runs north-south along the eastern edge of the KPT facility, then extends east between the Reliance and Yale Oil facilities (ThermoRetec 2001).

Groundwater elevation contour maps have been generated from water level data collected from wells screened near the water table in the upper confined aquifer and from a few wells screened deeper in the upper unconfined aquifer. Data for the deeper wells are generally similar to data collected from the shallow wells; the flow direction in the deep wells is from the northwest to the southeast. In addition, vertical gradients from shallow and deep monitoring wells located in the upper unconfined aquifer have been measured in four well pairs. Only one well pair (GW-5 and KPT-15) showed an upward gradient in the October 2004 sampling event (RETEC 2004). Well pair GW-5 and KPT-15 have consistently shown an upward gradient. The remaining well pairs (KPT-7 and KPT-8; KPT-9 and KPT-13; and KPT-11 and KPT-14) showed a slight downward vertical gradient. Vertical gradients from these paired wells have been found to vary over time and location. Groundwater elevation contour maps from October 2004 for the upper and lower portions of the unconfined aquifer are provided in Figures 3-3 and 3-4.

An environmental investigation was completed on the Seaman Mobile Homes property, located just east of Highway 2, which provides additional information on the local hydrogeology (Spratt 1992). Groundwater flow velocities were measured in several wells using a K-V Associates Geoflow heat pulse flow meter. In addition, several slug tests and pumping tests were conducted on selected monitoring wells at the site.

Groundwater flow velocities were measured in three wells at rates of 0.70 feet per day (ft/day), 5.63 ft/day, and 6.29 ft/day. Calculated values of K from four slug tests ranged from 0.547 to 321.92 ft/day. Calculated values of K from three “short-term” pumping tests ranged from 0.44 ft/day to 12.07 ft/day (Spratt 1992). The reported pumping rate was 0.94 gpm; the pumping time, time of recovery, and method of data analysis for the tests was not reported (Spratt 1992). The Spratt report indicates the higher K values indicate higher permeable material, typical of river gravels, and that the lower K values suggest less permeable, floodplain deposits (Spratt 1992). However, Spratt did not provide well logs in their report, and apparently did not use well logs to confirm the difference in subsurface materials in drawing their conclusions. A well log for pumping well EH-2 was located and indicates silt and clay with minor gravel grading to silt and sand with minor gravel to 16.5 ft bgs (Tetra Tech Inc. 1995a); well logs for pumping wells EH-1 and EH3 could not be located. Lastly no additional information regarding hydraulic conductivity has been located to date for either the Evergreen Water District wells, or wells installed as part of Tetra Tech Inc.'s investigation (Tetra Tech Inc. 1995a).

3.6.5 Preliminary Well Inventory Information

A well inventory was prepared to identify monitoring wells, domestic wells, and public water supply wells in the vicinity of the KRY sites. TTEMI downloaded Montana Bureau of Mines and Geology (MBMG) Ground Water Information Center (GWIC) wells from the Natural Resource Information System (NRIS) Geographic Information System web page for Montana, which contains wells drilled in the state between the years 1860 and 2005, to locate domestic and public water supply wells in the vicinity of the KRY site. Using the facility boundaries as outlined by DEQ, a one-half-mile buffer was created around the facility properties. The database was queried for this defined area; 179 wells were located in the database, including several wells located within the properties. All locations of domestic and public water supply wells were then plotted (Figure 3-5). According to GWIC, the well database depends on well drillers accurately filling out and filing a form with the Montana Bureau of Mines and Geology after well installation is complete. Unfortunately, the forms are not always filed, as GWIC estimates that 60 to 70 percent of the wells actually drilled appear in the database.

In addition, locations of most GWIC wells have not been precisely established, either through surveys or global positioning system. Instead, wells are located by township, range, section, and quarter sections. As a result, existing GWIC wells may not have a unique location within any given quarter section. Instead, multiple locations will appear to be stacked on top of each other (Figure 3-5). Therefore, GWIC well locations will require field verification to improve the accuracy and reliability of the information provided in the GWIC database.

A comprehensive well inventory for all monitoring wells, domestic wells, and public water supply wells at the KRY site and within the half-mile buffer is provided on Table B-1 in Appendix B.

As part of the process of preparing a comprehensive well inventory, TTEMI reviewed existing KRY site documents and transferred all on-site monitoring well locations from existing figures to a single digitized base map using CADD. The monitoring well locations were then transferred and plotted at the appropriate scale on a map of the KRY site and vicinity (Figure 3-6). Well information from site monitoring is summarized on Table 3-4.

Public Water Supply Wells

A preliminary database query of public water supply wells located in the vicinity of the KRY site was completed. The NRIS Digital Atlas, Environmental and Water Database were queried, as well as the GWIC database. Seven public water supply wells were identified in the query. However, upon further discussion with personnel at the Evergreen Water and Sewer District, only four of the seven wells are actually near the KRY site. Public water supply identification information is provided in the table below.

The Evergreen Water and Sewer District operates two wells located just northeast of the Reliance facility on Flathead County shop property (Figure 3-6). One well was installed in 1967, is reportedly 85 feet deep, and yields 2,000 gpm. The second well was installed in 1975, is reportedly 143 feet deep, and yields 3,000 gpm MBMG, 2005). Both wells are currently in operation. DEQ’s web site provides information on public water supplies including operator information, water quality analyses (arsenic, radiums combined, gross alpha, inorganics, synthetic organic chemicals [SOC], and VOCs), sample collection dates, and violation dates (if any). Evergreen Water and Sewer District supply wells are sampled at the entry point, not individually. No organic COPCs have been detected in samples from these wells and other detected constituents have been reported below drinking water standards.

Two other public water supply wells are located south of the KRY site and south of the gravel pit: 1) the Conrad Athletic Complex well (also listed as the Conrad Cemetery well) and 2) the Greenwood Corporation RV and Mobile Home Park Well #1. No information regarding the installation or completion information was found on the Greenwood Corporation well. The Conrad well is reportedly 391 feet deep and yields 1,500 gpm. It supplies irrigation and drinking water for use at the athletic complex. Water quality data from these public water supply wells are available on DEQ’s website, and includes arsenic, radiums combined, gross alpha, inorganics, SOCs, and VOCs.

Well Name	Public Water Supply Number	Entry Point (Sample Point)
Flathead County Water and Sewer #1	MT0001744 WL005	503
Flathead County Water and Sewer #2	MT0001744 WL006	503
Conrad Athletic Complex	MT0003025	NA
Greenwood Corporation RV and Mobile Home Park Well #1	MT0003602	NA

Notes:
NA Not applicable
Reference: www.deq.state.mt.us/wqinfo/pws/reports.asp

4.0 DATA EVALUATION

This section summarizes existing chemical data and other relevant data for the KRY site, including an assessment of data quality and data gaps. In addition, this section provides comparisons of existing data with screening criteria. Historic sampling activities that have generated site data are summarized in Section 3.0. Media sampled to date include groundwater, soil, sludge, waste, product, and surface water. Data summary tables for all organic and inorganic analyses are provided in Appendix D.

Analytical results for existing groundwater, soil, sludge, waste, and product samples were screened against all of the criteria listed below to identify media and locations where contaminant concentrations may be of concern. These exceedances are highlighted in shaded boxes on the tables in Appendix D.

For groundwater, screening criteria include:

- EPA Region 9 tap water preliminary remediation goals (PRG) (appropriate for drinking water samples) (EPA 2004)
- EPA secondary maximum contaminant levels (MCL) (EPA 1992b)
- Montana numeric water quality standards (WQB-7 standards) for groundwater (DEQ 2004)
- Montana Risk Based Corrective Action (RBCA) Tier 1 groundwater risk-based screening levels (RBSL) (DEQ 2003)

For soil and sludge, screening criteria include:

- EPA Region 9 industrial and residential PRGs (EPA 2004)

- EPA Region 9 soil screening levels based on protection of groundwater at a dilution attenuation factor of 10 (EPA 2004)
- Montana RBCA Tier 1 soil RBSLs (DEQ 2003)
- Montana generic residential soil action level for arsenic (DEQ 2005a)

The following sections describe the existing site data for groundwater, soil, sludge, and other data.

4.1 GROUNDWATER DATA

Table 4-1 presents a summary of analytes detected in groundwater at the KRY site, frequency of detection, maximum detected concentrations, and groundwater screening criteria. Detected compounds include volatile organic compounds (VOCs), SVOCs, pesticides, dioxins and furans, petroleum hydrocarbons, and metals. All available groundwater chemical data are presented in Appendix D. Historic groundwater sampling locations and the approximate extent of pentachlorophenol and LNAPL contamination are shown on Figure 4-1. No background groundwater samples were identified.

4.2 SOIL DATA

Table 4-2 and Table 4-3 present summaries of analytes detected in soil at the KRY site, frequency of detection, maximum detected concentrations, and soil screening criteria. Table 4-2 presents data for surface soil from 0- to 2-feet bgs. Table 4-3 presents data for soil samples greater than 2 feet bgs. Detected compounds include VOCs, SVOCs, dioxins and furans, petroleum hydrocarbons, and metals. All available soil chemical data are presented in Appendix D. Copies of historic figures showing soil sampling locations are included in Appendix E.

Four soil samples were obtained from locations considered background or ambient by previous investigators. Sample RR-SS-08 was taken from a location near the Stillwater River approximately 3,000 feet west of the Yale Oil facility. Analytical results of soil sample RR-SS-08 were nondetect for dioxins and furans. Sample SS-1, located in the residential area north of Reliance Refinery, had detectable SVOCs, dioxins and furans. The sample was also collected from a yard indicating that it was in a previously disturbed area. Sample SS-5, located approximately 1200 feet southwest of Reliance Refinery on a ridge that appeared to be undisturbed, contained detectable petroleum hydrocarbons and dioxins and furans indicating the area may have been impacted. Sample SS-4, located in the gravel pit south of Flathead Drive, also had detectable levels of petroleum hydrocarbons, dioxins and furans. The gravel pit is a disturbed area. That, combined with detected contaminants indicate the sample may not be considered a true background sample. An "ambient soil" sample (referred to in the 1985 Applied Earth Sciences report -Subsurface Investigation and Remedial Action Plan Exxon Bulk Plant) was collected at the Yale Oil facility in an area that appeared not to be affected by product. The sample did have one COPC detected (bis[2-ethylehexyl]phthalate at 9,400 µg/kg). Without the exact location, the sample cannot be considered a representative a background sample.

4.3 SLUDGE, WASTE, AND PRODUCT DATA

Table 4-4 presents summaries of analytes detected in sludge, waste, and product at the KRY site, frequency of detection, maximum detected concentrations, and soil screening criteria. Detected compounds include SVOCs, dioxins and furans, metals, and petroleum hydrocarbons. All available sludge, waste, and product chemical data are presented in Appendix D. Copies of historic figures showing sludge sampling locations are included in Appendix E.

4.4 OTHER DATA

Pertinent sampling data from other sources have been incorporated into the DSR including surface water data for the Stillwater River, data from nearby UST sites, and public water supply monitoring information. During the review of DEQ site files and other sources, no sampling data were found for stream/river sediment, air, or soil gas.

4.5 DATA QUALITY EVALUATION

TTEMI conducted a review of available historical data for the KRY site in order to evaluate, if possible, the accuracy, precision, overall quality, and usability of available data (Appendix C). TTEMI will review additional data sets as they become available. Data were received by TTEMI in various formats and included both hardcopy and electronic deliverables. The available data have been incorporated into an electronic database to assist with data management and future site evaluation.

4.5.1 Approach

Available QA and QC data were reviewed in conjunction with sample data. Because of the extended span of time during which these data were collected, the varying scopes of each investigation, and different laboratory reporting styles, a consistent review of all required QA/QC measures across the board was not possible. However, assessments or partial assessments of accuracy, precision, overall quality, and usability were made when applicable QC information was provided. Since no full data validation packages were available for review, the review relied on analytical results and, where available, QC summaries associated with sample results. The review consisted of a basic accounting of available data, followed by an assessment of quality based on the QC parameters for precision and accuracy. An in depth review of all data and QC parameters, including chain of custody forms and sample holding times, was not conducted as part of the DSR but may be appropriate for data sets that have not been fully validated.

Precision is assessed by comparing analytical results of matrix spike (MS) and matrix spike duplicate (MSD) pairs, matrix duplicates (MD) pairs, field duplicate pairs, laboratory control sample (LCS); and LCS duplicate pairs. Precision is calculated using relative percent difference for two measurements and relative standard deviation for more than two measurements.

Accuracy is assessed by using the recoveries of MS, MSD samples, surrogate spikes, LCSs, standard reference materials, performance evaluation samples, and measurements of instrument responses from calibration standards. Accuracy is generally expressed as percent recovery of the analyte of interest based on a known or true value. Laboratory and field blank results also provide useful information regarding accuracy of results.

4.5.2 Results

Data for which QC summaries or data validation reports were available were found to be in sufficient quality for use in further characterization of site matrices and support of risk assessment. This review indicates the available data fall into four categories as described below:

- Rejected data – These data cannot be used for further characterization or risk assessment evaluations.
- Data with no review (for which there is no available QC or supporting analytical data) – These data can be used qualitatively, but should be supported with validated data.
- Data with full validation (that is not rejected) – These data can be used both qualitatively and quantitatively for all intended purposes.

- Data with partial validation or review (where selected results and QC data are validated) – These data may be used to improve efficiency in the overall project decision-making, provided that critical samples or critical analytes are reviewed.

Table 4-5 provides a summary of the investigations, investigation activities, and the overall data quality assessment as evaluated for each investigation using the categories provided above. In addition, rejected data that should not be used further include the following:

- Results for 2-butanone, 2-chloroethylvinyl ether, and vinyl acetate obtained from the 1986 Yale Oil Site Report of Sampling Activities.
- Results for antimony, arsenic, cadmium, lead, mercury, selenium, and thallium samples obtained from the 1986 Reliance site investigation.
- Several dioxin and furan isomers for one sample from the 1991 Preliminary Extent of Soil Contamination and Hydrogeological Investigation.
- Acrolein result for one sample from the 1994-1995 Burlington Northern Railroad Site Investigation.

4.6 DATA GAP ASSESSMENT

This section summarizes data gaps that are considered critical in order to complete an RI/FS for the KRY site. Data gaps have been evaluated and are summarized below in six areas including (1) physical characteristics and environmental setting, (2) nature and extent of contamination, (3) fate and transport of contaminants of potential concern (COPC), (4) human health risk assessment, (5) ecological risk assessment, and (6) identification and analysis of remedial technologies and cleanup alternatives.

(1) Physical Characteristics and Environmental Setting

- Verification of groundwater monitoring, residential, and public water supply well status, either existing or abandoned possibly through door-to-door survey.
- Survey all existing well locations to a known USGS benchmark including field verification of the actual location of private wells and the public water supply wells. Although location coordinates of some wells have been obtained, some of these locations are suspect; for example, some well locations plot on roadways and elevation data for some wells differ between reports.
- Groundwater flow magnitude and direction in proximity to the Stillwater River and buried paleochannels located south of the river.
- Interaction of the river and groundwater in the vicinity of the KRY site will be verified through comparison of static water levels and water quality parameters.

- Verification of any threatened or endangered species or special wildlife management areas.
- Horizontal and vertical hydraulic gradients through evaluation of water level, pumping test, and slug test information
- Existing slug test data provide limited hydrogeologic information. Short duration (4 hours or less) pumping tests should be conducted to provide more representative aquifer hydrogeologic properties.

<u>(2a) Nature and Extent of Surface Soil Contamination</u>

The horizontal limits of surface soil contamination have been identified as a data gap. Soil sampling will be needed to determine the areal extent of contamination as defined by non-detected values or until background concentrations are indicated. All surface soil samples will be analyzed for VOCs, SVOCs (including PAHs), EPH, and VPH. A smaller subset of samples will be analyzed for dioxin, furans, and metals. Sampling will generally be conducted in areas not previously sampled to delineate areal extent of contamination. Data gaps have been identified in the following areas:

KPT Facility and Vicinity

- Northern portion of KPT facility within the Stillwater river meander where there has been historic evidence of pole storage and earth moving
- Central portion of facility outside of historic sampling and soil removal areas
- Southern portion of facility south of railroad tracks and toward McElroy & Wilken gravel pit
- Eastern portion of facility near the Reliance facility
- Western portion of facility near Klingler Lumber operations
- Along the railroad right-of-way

Reliance Facility and Vicinity

- Southern portion of Reliance facility, south of fence line and toward McElroy & Wilken Gravel Pit
- Eastern portion of facility from fence line toward Pacific Steel & Recycling
- Northern portion of facility
- Around fenced sludge area northeast of main railroad line
- Along railroad right-of-way

Yale Oil Facility and Vicinity

- Most of the Yale Oil facility area is either hardscape or paved; therefore, surface soil samples will be collected in unpaved areas.

- South of Office Max between Mini-Storage/Rocky Mountain Marine and Highway 2

- Most of the Seaman/Shelton area is either hardscape or paved; therefore, surface soil samples will be collected in unpaved areas.

Determination of Background

- Existing background surface soil data is limited and will be supplemented with samples from three uncontaminated locations. Samples will be analyzed for dioxins and furans, metals, and PAHs. Other COPC background concentrations are assumed to be zero.

Investigation of Aerial Deposition of Dioxins and Furans

- Dioxin and furan samples will be collected along the principal downwind vector according to the local wind rose, if available. In addition PCP data will be collected for residential yards.

<u>(2b) Nature and Extent of Subsurface Soil Contamination</u>

- Soil contamination associated with all LNAPL smear zones

<u>(2c) Nature and Extent of Groundwater and LNAPL Contamination</u>

- Delineate upgradient background concentrations of COPCs in groundwater west of monitoring wells KPT-1 and KPT-12

- Delineate southern extent of LNAPL contamination and dissolved groundwater plume south of monitoring wells KPT-3 and KPT-4

- Delineate areal extent of LNAPL contamination adjacent to locations where recoverable floating product are currently observed

- Delineate the lateral boundaries of the contaminant plume both north and south of monitoring wells GWY-10, GWY-14, and PW-1

- Delineate potential groundwater contamination east of crude oil spills and fenced off sludge area east of Reliance facility

- Assess groundwater flow and contaminant migration in the vicinity of the reported groundwater mound at the Reliance facility

- Evaluate the potential for groundwater contamination in the residential area north of the Rask Well

- Evaluate the potential for groundwater contamination in the deeper confined aquifer

- Evaluate the potential for groundwater contamination north of the KPT facility within the Stillwater River meander and north toward the Reliance facility

- Evaluate the relationship of the perched groundwater mound at the Reliance facility with the Stillwater River and extent of contamination within this area

(3) Fate and Transport of COPCs

- Completion of an analytical fate and transport model to evaluate migration of contaminants from the vadose zone to groundwater in order to develop soil cleanup levels protective of groundwater

- Vadose and saturated zone soil physical or chemical properties including soil particle size gradation, soil bulk density, soil particle density, synthetic precipitation leaching procedure analysis, and fraction of organic carbon

(4) Human Health Risk Assessment

- COPC soil and groundwater data including metals for additional KRY site areas delineated during the RI

- Data to establish background concentrations in soil and groundwater for dioxins and furans and for metals including arsenic

- Groundwater quality data from a single, comprehensive, site-wide sampling event

- Evaluate indoor air/vapor migration from soil and/or groundwater

- Surface water and sediment data from the Stillwater River adjacent to the site including one upgradient location

(5) Ecological Risk Assessment

- Habitat survey to establish habitat areas and indigenous species

- Surface water and sediment data from the Stillwater River adjacent to the site including one upgradient location

(6) Identification and Analysis of Remedial Technologies and Cleanup Alternatives

- Monitored natural attenuation data (to be collected by Western Research Institute)

- Groundwater and soil microbiology (to be collected by Western Research Institute)

- Pumping test data for evaluation of hydraulic conductivity and hydrogeologic parameters including conductivity across suspected aquitard between the upper unconfined aquifer and the deeper confined aquifer

- Vadose and saturated zone soil physical or chemical properties including soil particle size gradation, soil bulk density, soil particle density, and fraction of organic carbon

- Pilot tests or other data for evaluation of LNAPL capture, containment and recovery

- Operations and monitoring data for the ozonation system installed at the KPT facility

- Completion of an analytical fate and transport model to evaluate migration of contaminants in groundwater for various cleanup scenarios including no action and source removal alternatives

5.0 CONTAMINANTS OF POTENTIAL CONCERN

COPCs are currently being evaluated by screening all analytes detected in solid and liquid media at the KRY site. A full evaluation will be completed once all discrepancies are corrected in the current database. Currently, an assessment of contaminants at the site identified PCP, dioxin and furans, PAH, TPH, EPH/VPH, and lead as preliminary COPCs.

The presence of other COPCs at the KRY site is acknowledged. Further evaluation of the data and collection of additional data may expand the list of COPCs. TTEMI, in conjunction with DEQ, will select screening criteria that may include, but will not be limited to, the extent, concentrations, and sources (including petroleum releases) of the contaminants in each media type to aid in proper identification of the COPCs upon further completion of the RI process. The following subsections discuss the physical and chemical characteristics along with the general toxicological information of each of these preliminary COPCs.

5.1 GENERAL PHYSICAL AND CHEMICAL PROPERTIES

This section describes the general physical and chemical properties of chemicals identified as COPCs.

5.1.1 Pentachlorophenol

PCP is a white organic solid with needle-like crystals and a very sharp, phenolic odor. The greatest use of PCP is as a wood preservative (fungicide) for utility poles, cross arms, fence posts, and similar structures.

PCP was used at the KPT facility as a wood preservative. Though once widely used as a herbicide, it was banned in 1987 for these and other uses, as well as for over-the-counter sales (EPA 2005).

PCP does not occur naturally in the environment. It can be found in the air, water, and soil. It enters the environment through evaporation from treated wood surfaces, industrial spills, and disposal at uncontrolled hazardous waste. PCP is readily broken down by sunlight, other chemicals, and microorganisms to other chemicals within a few days to months (Agency for Toxic Substances and Disease Registry [ATSDR] 2001a). It is produced by the chlorination of phenol. Impure PCP, which is most likely to be found at hazardous waste sites, is a dark gray to brown dust, beads, or flakes (National Safety Council [NSC] 2005). PCP is a non-flammable solid, which does not evaporate easily. It exists in two forms: the nonpolar form dissolves easily in water, and the other form does not. PCP organic solvents are freely soluble in alcohol, soluble in benzene, and slightly soluble in cold petroleum ether. PCP rapidly degrades in air and surface water (NSC 2005). Under optimum conditions, PCP may also degrade in soils.

5.1.2 Dioxin

Chlorinated dibenzo-p-dioxins (CDD) are a family of 75 chemically related compounds commonly known as chlorinated dioxins (ATSDR 1998). One dioxin compound (2,3,7,8-TCDD) is one of the most toxic of the CDDs and is the one most studied. Dioxins may be naturally produced from the incomplete combustion of organic material by forest fires or volcanic activity. Dioxins are not intentionally manufactured by industry, except in small amounts for research purposes. They are unintentionally produced by industrial, municipal, and domestic incineration and combustion processes. Dioxins and furans are always found with PCP and this is considered the primary source of dioxin and furan contamination at the KRY site.

Combustion generated chlorinated dioxins may be transported long distances (as vapors or associated with particulates) in the atmosphere (Czuczwa and Hites 1986a, 1986b; Tysklind et al. 1993). They may eventually be deposited on soils, surface waters, or plant vegetation as a result of dry or wet deposition. Chlorinated dioxins deposited on soils will strongly adsorb to organic matter. Chlorinated dioxins, unless present in carrier solutions (such as is the case at the KRY site), typically do not leach to underlying groundwater but may enter the atmosphere on soil dust particles or enter surface waters on soil particles in surface runoff. When present in carrier solutions (such as diesel), dioxin may migrate with the carrier solution in the vadose zone and groundwater. Low water solubility and high lipophilicity indicate that chlorinated dioxins will bioconcentrate in aquatic organisms, although, as a result of their binding to suspended organic matter, the actual uptake by such organisms may be less than predicted.

5.1.3 Polycyclic Aromatic Hydrocarbons

The compounds benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)-fluoranthene, chrysene, indeno(1,2,3-CD)pyrene, and naphthalene belong to the group of compounds known as PAHs. PAHs are defined as compounds containing two or more aromatic rings. For the purpose of describing environmental fate, these PAHs can be grouped into low, medium, and high molecular weight classes. PAHs are released to the environment from natural and manmade sources. Manmade sources now provide a much greater release volume than natural sources. PAHs are common constituents of petroleum hydrocarbon mixtures such as diesel, motor oil, and asphalt. PAHs also result from incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. They are also found in creosote, dyes, paints, plastics, insulating materials, building materials, and rubber.

In general, PAHs have low water solubility and may increasingly sorb to soil or particles within groundwater with increasing soil organic carbon. The less organic carbon found in the soil system, the more mobile are the PAH compounds. Sorption to soil particles is the primary process responsible for their removal from aqueous systems. PAHs have Henry's Law constants ranging from 10^{-5} to 10^{-8} atmospheres per cubic meter per mole (atm-m^3/mol). Compounds with values less than 10^{-5} atm-m^3/mol volatilize from water only to a limited extent (Lyman and others 1982). The organic carbon partition coefficient (K_{oc}) indicates the chemical's potential to bind to organic carbon in soil and sediment. The high-molecular-weight PAHs have K_{oc} values in the range of 10^{-5} to 10^{-6}, which indicates a strong tendency to adsorb to organic carbon (ATSDR 2001b).

Sorption of PAHs to soil and sediment increases with increasing organic carbon content and is also directly dependent on particle size. Smaller particles with higher surface-area-to-volume ratios are more efficient at sorbing PAHs. Sorption has been correlated with bioconcentration in aqueous organisms. Information on the organic metabolism of PAHs in the subsurface environment is often conflicting; however, it appears that the three simplest PAHs, naphthalene, anthracene, and phenanthrene, are the only compounds of this class that support the growth of microorganisms. None of the more complex PAHs has been shown to support growth when present as the sole carbon source (Ribbons and Eaton 1982). In addition, hydrolysis is not considered to be an important degradation process for PAHs (ATSDR 1990); therefore, PAHs are very persistent in the environment.

5.1.4 Total Petroleum Hydrocarbons

TPH is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil (ATSDR 1999). Petroleum hydrocarbons are typically used as fuels, solvents, or chemical intermediates. The volatility of a compound generally decreases with increases in carbon number range and boiling range. The TPH-e group includes diesel-range organic compounds, motor oil range compounds, and other extractable fuels. TPH-e found in the environment at the KRY site is associated with wood-treating and petroleum refinery activities, as well as leaks from the Yale Oil Corporation bulk storage facility.

Diesel-range organic compounds and motor oil range compounds are composed primarily of aliphatic hydrocarbons that fall in the C10 to C20 range. As much as approximately 25 percent of TPH may be composed of aromatic hydrocarbons consisting of alkylated benzenes and naphthalenes. Petroleum hydrocarbons are generally less dense than water (applies for diesel and fuels lighter than No. 6 fuel oil), and, because of its higher molecular weight, is less volatile, less water soluble, and less mobile than are the gasoline range. Diesel-range organic compounds and motor oil range are expected to have a stronger tendency for adsorption to the surface of soils.

5.1.5 Lead

Lead is a constituent of many minerals and is a commonly detected element in soils and sediments. Lead is also found historically in many manmade products including fuels, paints, and batteries. Naturally occurring lead in soils is often strongly sorbed to sediments, particularly fine-grained material that contains clay. Generally, lead does not tend to be mobile in aquatic environments. The presence of elevated lead concentrations at the KRY site is believed to be associated with fuel additive processes at the Reliance facility.

Most lead is retained strongly in soil, and very little is transported into surface water or groundwater (EPA 1979; National Science Foundation [NSF] 1977). Clays, silts, iron and manganese oxides, and soil organic matter can bind metals electrostatically (cation exchange) as well as chemically (specific adsorption) (Reed et al. 1995). Lead is strongly sorbed to organic matter in soil.

The downward movement of elemental lead and inorganic lead compounds from soil to groundwater by leaching is very slow under most natural conditions except for highly acidic situations (NSF 1977).

Biotransformation of lead can occur by microorganisms present in sediments. A volatile compound that results from biomethylation, tetraethyl lead, can either be oxidized in the water column or enter the atmosphere; this process enables lead in sediment to enter both the aqueous and gaseous phases (EPA 1979).

5.2 GENERAL TOXICOLOGICAL INFORMATION

This section describes general toxicological information of chemicals identified as COPCs.

5.2.1 Pentachlorophenol

PCP is significantly toxic to mammals, plants, and many microorganisms. However, bacteria have been found that are resistant to relatively high PCP concentrations and can metabolize it to carbon dioxide and chloride. Bacteria have been successful in the bioremediation of PCP (University of Minnesota Biocatalysis/Biodegradation Database 2005).

PCP can enter the body when breathed in with air, consumed with contaminated food or water, absorbed through dermal contact, or incidental ingestion from contaminated soil. Exposure to high levels of PCP can cause the cells in the body to produce excess heat. When this occurs, a person may experience a very high fever, profuse sweating, and difficulty breathing. At this time, the body temperature may increase to dangerous levels, causing injury to various organs and tissues, and possibly death. Liver effects and damage to the immune system have also been observed in humans exposed to high levels of PCP for a long time ATSDR 2001a). PCP is a Class B probable human carcinogen.

5.2.2 Dioxins and Furans

Dioxins are known to be human carcinogens based on sufficient evidence of carcinogenicity from studies in humans (U.S. Department of Health and Human Services 2002). Studies published through 1996 demonstrated statistically significant increases in relative risks for all cancers combined, lung cancer, and non-Hodgkin's lymphoma among highly exposed sub-cohorts. Many independent animal studies of TCDD have all found TCDD to be carcinogenic. Tumors have been produced in rats, mice, and hamsters, in both sexes, in various strains, in multiple organs and tissues, and from multiple routes of dosing, including gastrointestinal (gastric instillation or dietary), dermal, and intraperitoneal. TCDD exposure leads to an increased frequency of cancers in a dose-dependent fashion. Increased incidences of cancers in laboratory animals following TCDD exposure include the following organs or systems; hepatobiliary, thyroid, lymphatic, respiratory, adrenal cortex, hard palate, nasal turbinates, tongue, and skin (Huff *et al.* 1994). EPA considers dioxins and furans to be probable human carcinogens while the World Health Organization (WHO) considers them to be known human carcinogens.

The most common noncarcinogenic effects for contact with dioxins via dermal contact and incidental ingestion are presented below. The most widely recognized effect of dermal exposure is chloracne (EPA 2003). Secondary effects include dermal inflammation, irritation, hyperpigmentation, and hirsutism (also known as hypertrichosis or abnormal distribution of hair). Noncarcinogenic effects associated with incidental ingestion of dioxins are more extensive and affect nearly every organ system. Predominant effects from incidental ingestion include changes in liver function and structure after exposure; this is demonstrated by an increased liver size and changes in hepatic enzyme levels. In addition, dioxins produce negative effects to the thyroid, kidney, neurological system, circulatory system, pulmonary system, immune system, and development and reproduction of children (EPA 2003).

The polychlorinated dibenzodioxins (CDDs) include 75 individual compounds, and the polychlorinated dibenzofurans (CDFs) include 135 individual compounds. These individual compounds are technically referred to as congeners. Only 7 of the 75 congeners of CDDs are thought to have dioxin-like toxicity; these are ones with chlorine substitutions in, at least, the 2, 3, 7, and 8 positions. Only 10 of the 135 possible congeners of CDFs are thought to have dioxin-like toxicity; these also are ones with substitutions in the 2, 3, 7, and 8 positions.

For risk assessment purposes, a toxicity equivalency procedure was developed to describe the cumulative toxicity of these mixtures. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the CDD, CDF, and PCB congeners. TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of TCDD, which is assigned a TEF of 1.0. All other congeners have lower TEF values ranging from 0.5 to 0.00001. Generally accepted TEF values for CDD/Fs are shown in the following table.

ANALYTE	89 EPA TEF	98 WHO TEF
1,2,3,4,6,7,8-HPCDD	0.01	0.01
1,2,3,4,6,7,8-HPCDF	0.01	0.01
1,2,3,4,7,8,9-HPCDF	0.01	0.01
1,2,3,4,7,8-HXCDD	0.1	0.1
1,2,3,4,7,8-HXCDF	0.1	0.1
1,2,3,6,7,8-HXCDD	0.1	0.1
1,2,3,6,7,8-HXCDF	0.1	0.1

ANALYTE	89 EPA TEF	98 WHO TEF
1,2,3,7,8,9-HXCDD	0.1	0.1
1,2,3,7,8,9-HXCDF	0.1	0.1
1,2,3,7,8-PECDD	0.5	1
1,2,3,7,8-PECDF	0.05	0.05
2,3,4,6,7,8-HXCDF	0.1	0.1
2,3,4,7,8-PECDF	0.5	0.5
2,3,7,8-TCDD	1	1
2,3,7,8-TCDF	0.1	0.1
OCDD	0.001	0.0001
OCDF	0.001	0.0001

Calculating the toxic equivalency (TEQ) of a mixture involves multiplying the concentration of individual congeners by their respective TEF. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture.

5.2.3 Total Petroleum Hydrocarbons

Health effects from exposure to TPH depend on many factors (ATSDR 1999). These include the types of chemical compounds in the TPH, how long the exposure lasts, and the amount of the chemicals contacted. Very little is known about the toxicity of many TPH compounds. Until more information is available, information about health effects of TPH must be based on specific compounds or petroleum products that have been studied.

The compounds in some TPH fractions can affect the blood, immune system, liver, spleen, kidneys, developing fetus, and lungs (ATSDR 1999). Certain TPH compounds can be irritating to the skin and eyes. Other TPH compounds, such as some mineral oils, are not very toxic and are used in foods.

Exposure pathways at the site were identified on the basis of several factors, including site configuration, land use, and activity patterns. In addition, this information is important for evaluating potential migration pathways and determine whether more site data are needed. All potentially complete exposure pathways will be either quantitatively or qualitatively evaluated in the Risk Assessment. A complete exposure pathway includes all of the following elements:

- A source and mechanism of contaminant release
- A transport or contact medium (e.g., groundwater or soil)

- An exposure point where humans can contact impacted media
- An exposure (intake) route, such as ingestion or inhalation

The absence of any one of these elements results in an incomplete exposure pathway. When there is no potential human exposure pathway, there can be no potential human health risk. The routes of exposure that will be quantitatively evaluated in the human health risk assessment may include the following:

- Incidental ingestion (produce or fish)
- Dermal contact
- Inhalation of particulates or volatile organic chemicals

5.2.4 Polycyclic Aromatic Hydrocarbons

B(a)P equivalency factors are used to assess the total toxicity at a sample location for PAHs detected, expressed relative to the toxicity of benzo(a)pyrene. In addition to benzo(a)pyrene, six other PAHs are classified by EPA as probable human carcinogens. The six PAHs include benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)-pyrene (EPA 1993). With the established carcinogenicity of benzo(a)pyrene, the other six compounds have been estimated to be 1 to 1000 times less carcinogenic (EPA 1993). As a result, the general toxicological information presented in this section will be discussed for benzo(a)pyrene.

Benzo(a)pyrene is readily absorbed following inhalation, oral, and dermal routes of administration. Following inhalation exposure, benzo(a)pyrene is rapidly distributed to several tissues in rats. The metabolism of benzo(a)pyrene is complex and includes the formation of a proposed ultimate carcinogen, benzo(a)pyrene-7,8-diol-9,10-epoxide. Dietary administration of doses of 10 mg/kg during gestation caused reduced fertility and reproductive capacity in mice offspring, and treatment by gavage with 120 mg/kg/day during gestation caused stillbirths, resorptions, and malformations (Risk Assessment Information System [RAIS] 2004). No data are available on the systemic (non-carcinogenic) effects of benzo(a)pyrene in humans.

Numerous epidemiologic studies have shown a clear association between exposures to various mixtures of PAHs containing benzo(a)pyrene (e.g., coke oven emissions, roofing tar emissions, and cigarette smoke) and increased risk of lung cancer and other tumors. However, each of the mixtures also contained other potentially carcinogenic PAHs; therefore, it is not possible to evaluate the contribution of benzo(a)pyrene alone to the carcinogenicity of these mixtures.

5.2.5 Lead

Human exposure to lead occurs primarily through diet, air, drinking water, dust, and paint chips. The efficiency of lead absorption depends on the route of exposure, age, and nutritional status. Adult humans absorb about 10-15 percent of ingested lead, whereas children may absorb up to 50 percent, depending on the exposure medium (RAIS 2004). The systemic toxic effects of lead in humans have been well documented. The evidence shows that lead is a multi-targeted toxicant, causing effects in the gastrointestinal tract, hematopoietic system, cardiovascular system, central and peripheral nervous systems, kidneys, immune system, and reproductive system. Lead can affect almost every organ and system in the human body. The most sensitive system is the central nervous system, particularly in children. Irreversible brain damage occurs at blood lead levels greater than or equal to 100 micrograms per deciliter (µg/dL) in adults and at 80 to 100 µg/dL in children; death can occur at the same blood levels in children. Children who survive these high levels of exposure suffer permanent, severe mental retardation. Lead also damages kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may also cause anemia, a disorder of the blood (RAIS 2004).

EPA has evaluated inorganic lead and lead compounds for carcinogenicity. The data from human studies are inadequate for evaluating the potential carcinogenicity of lead. Data from animal studies, however, are sufficient based on numerous studies showing that lead induces renal tumors in experimental animals. A few studies have shown evidence for induction of tumors at other sites (cerebral gliomas; testicular, adrenal, prostate, pituitary, and thyroid tumors).

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